

Time-Based Competition in Tesla's Supply Chain in the Era of Industry 4.0



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ABSTRACT

The aim of this Bachelor thesis is to show how Tesla operates in the automotive industry and how the company overcame the hurdles in Industry 4.0. For this purpose, the company is compared with its competitors, Volkswagen, and Lucid Motors. In particular, the supply chain of these companies will be compared and, finally, the example of the global chip shortage will be used to show how the individual companies mastered the crisis.

In this thesis, the terms Industry 4.0 and time-based competition are explained first. Then, Tesla's role in the automotive industry is explained along with the company's advantages. Then, Tesla is compared with Volkswagen and Lucid Motors, with a special focus on the supply chains. After this, the concrete example of the chip shortage is used to show how Tesla solved this problem compared to its competitors. Finally, a VRIO analysis is performed to show Tesla's advantage over the competition.

It is shown that Tesla has chosen a completely new and modern approach, which has never been seen before in the automotive industry. The company operates more like a tech company than an automaker. This allows it to solve problems faster and more efficiently.

Keywords Industry 4.0, Time-based competition, Tesla, automotive industry, supply chain

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1 INTRODUCTION

Industry 4.0 is an unavoidable topic in modern industry. The fourth industrial revolution brings with it many innovations, which were accelerated in particular in the wake of the Corona pandemic. One of the industries that is currently undergoing one of the biggest changes here is the automotive industry. The change of this industry in the course of the industry 4.0 are a component of this thesis.

This thesis deals with the question of how the car manufacturer Tesla has managed to permanently change the vehicle industry and how the company manages to stay one step ahead. It also analyzes the changes that other companies have undergone as a result of these market changes. The research question of this thesis is: How did the car manufacturer Tesla manage to change the vehicle industry in a sustainable way and how does the company manage to stay one step ahead?

The aim of this thesis is to show how Tesla has managed to change the car industry and what makes the company different. The transformation of the car industry and the most important aspects of it are clarified.

The thesis examines the topic through a qualitative analysis. For this purpose, secondary research is conducted. Furthermore, in the course of the thesis a qualitative case study is conducted, in which concrete results are to be found, which are to show Tesla's competitive advantage.

In the context of a competitor analysis, as well as the comparison of the supply chains of different companies, it will be analyzed which differences Tesla has to other companies, namely Volkswagen and Lucid Motors. The main differences will be identified and compared. Finally, a VRIO analysis is used to show where exactly Tesla's competitive advantages lie and why the company is so special in these.

This thesis is structured as follows:

In the second chapter, the theoretical framework is explained first. For this purpose, it is explained what Industry 4.0 is. To this end, the history of the previous industrial revolutions is first examined and contrasted with the fourth industrial revolution. It then describes what Industry 4.0 is exactly and how it relates to the automotive industry.

The concept of time-based competition is then explained, and this is also placed in the context of the fourth industrial revolution.

This is followed by a presentation of Tesla's role in the automotive industry. For this purpose, it is first explained who the Tesla company is in the first place and what it has achieved. Then, Tesla's advantages are elaborated, and it is shown why the company has a decisive competitive advantage over its rivals.

In the third chapter, the methodology of this thesis is explained. For this purpose, the qualitative research and the qualitative case study are discussed first, followed by a brief introduction of the concepts of SWOT analysis and VRIO analysis.

In chapter 4 the results are presented. For this purpose, a competitor analysis is conducted using the SWOT method. First, a general overview is given. Then, two competitors of Tesla are analyzed: First, the traditional car manufacturer Volkswagen and second, the new startup company Lucid Motors.

This is followed by a comparison of the supply chains of the two companies. It starts with an analysis of Tesla's supply chain itself, highlighting Tesla's advantages. Next, the supply chains of Volkswagen and Lucid Motors are analyzed. Finally, the supply chains are compared, and similarities and differences are identified.

These are then subsequently illustrated using an example. First, the global chip shortage is explained and the impact on Tesla and its competitors is shown.

The chapter then concludes with the VRIO analysis. Here, the VRIO framework is first explained. Then, a VRIO analysis of Tesla as a company is conducted. Finally, the results of the VRIO analysis are summarized.

In Chapter 5, recommendations are then made to show what other manufacturers could improve in order to catch up with Tesla and become competitive again in some areas.

The thesis concludes in Chapter 6 with a conclusion.

2 THEORETICAL FRAMEWORK

2.1 Industry 4.0

The following section will explain what exactly Industry 4.0 is. For this, the history of the industrial revolutions will first be explained, before it is explained what exactly the fourth industrial revolution is. This will then be further placed in the context of the automotive industry, and it will be shown what role the fourth industrial revolution plays here.

2.1.1 History of the industrial revolutions

Industrial revolutions have always been the biggest changes our modern society has gone through. In an industrial revolution, fundamental changes occurred that completely and forever changed the way of working, producing, or even of technology itself. Specifically, an industrial revolution describes the process of change. This goes from a handicraft

economy to a manufacturing industry in which machines and other novel technologies are used. (Sustainable Success, 2022)

In order to illustrate the impact of the fourth industrial revolution in more detail, the other three industrial revolutions and their impact on industry are briefly described below. There have been four industrial revolutions in total.

It started with the first industrial revolution (Industry 1.0), which took place between 1760 and 1840. It began in England and then spread to the USA. In this industrial revolution, production was mechanized for the first time. This was mainly accompanied by the use of steam power. Steam power was first used in industry in the course of Industry 1.0 and led to the greatest growth in productivity in human history. For example, clothes were made manually on a spinning wheel at the time, which had to be operated by sheer muscle power. The mechanical version meant that hardly any muscle power had to be used and thus accelerated this process eightfold. The switch to machines significantly increased the production volume, and for the first time there was a mass production. (Desouttertools, n. d.)

The most important new technologies at that time were all devices powered by steam or water. Probably the greatest invention here was the steam locomotive, which greatly simplified the transportation of goods as well as people. (Sustainable Success, 2022)

Industry 1.0 gave the starting signal for industrialization. During the first industrial revolution, the industry as a whole experienced a peak in growth and processes were accelerated rapidly for the first time. The quantity of production also increased significantly.

The second industrial revolution started in the 1870s in Germany, England and in America. Here, the things that were introduced in the first industrial revolution were continued and optimized.

In the industry 2.0, which is also known as technological revolution, machines were introduced for the first time, which were driven by electrical energy. Electric machines for production were invented in the course of the second industrial revolution. They offered some significant advantages over the water and steam engines of the first industrial revolution. They were much more efficient, easier to use, and also cheaper to operate. Furthermore, electrically powered machines required fewer resources, e.g., no more water or coal, and they were more cost-efficient. Another important point, which came in the second industrial revolution, was the expansion of the rail and telegraph network. This allowed people, but also information to be exchanged more easily, so that the first real, almost global, networking took place.

The most important achievement in Industry 2.0, however, was the first assembly line. This once again made it possible to significantly increase the quantity of production. For example, Oldsmobile Cars, which

patented the first production line, managed to increase its output by 500% in one year due to their first assembly line. (Dima, A., 2021)

Industry 2.0 continued what was started in the first industrial revolution. All inventions were optimized and further developed. The use of electricity then led to the next breakthrough, which is why the second industrial revolution could again lead to a significant increase in productivity in industry.

The third industrial revolution, also called the digital revolution, took place in the 1970s. Industry 3.0. was characterized by the invention of the first computers. These computers had a strong computing power for the time and provided the starting signal for the development of modern machines. The third industrial revolution thus led to the partial automation of production. However, at first only simple algorithms and simple computer systems were used, so human input was still essential. It only helped to further simplify processes but did not yet completely automate them. Information technology was also introduced for the first time, which was able to further simplify production.

The most important inventions that occurred in the course of the third industrial technology were to be found for the first time on the software and hardware side. On the software side, many IT systems were invented, including later the Internet, which simplified the exchange of information by a lot. On the hardware side, many new types of technological devices were invented, such as the personal computer. However, new technological devices were also constantly being used in production, which continued to simplify processes and take over the thinking process. For example, inventory could be tracked automatically using computer systems or product flows could be scheduled.

Industry 3.0 continued to greatly simplify the processes from the first two industrial revolutions and added a new critical component with the invention of the computer. The digitalization and partial automation of production were very important innovations that are still essential in any production today. It is also important to mention that the third industrial revolution is still present. The shift to automated processes is still taking place in many companies today. The robots that take over certain areas of a production are good examples of this. (Sustainable Success, 2022)

It can be seen that each of the three industrial revolutions had a major impact on industry in their own way.

The invention of the water and steam engine kicked off the first mass production and brought a significant increase in productivity for the first time. Later, electricity brought completely new machines and further facilitated production. Likewise, networking began to take off worldwide and a globally networked society emerged. Finally, the invention of the computer and modern IT systems brought another great leap in modern industry. Processes were automated and digitization progressed rapidly.

Next came the fourth industrial revolution, which once again fundamentally changed industry and brought many new aspects. In the following section, it will be explained what exactly Industry 4.0 is and how it has changed and is still changing the industry.

2.1.2 Industry 4.0 explanation

The fourth industrial revolution is currently taking place all over the world. It is the next stage in the development of the third industrial revolution. Characteristic of the fourth industrial revolution is the use of communication, as well as the use of smart communication systems throughout the industry. In the course of Industry 4.0, the digitalization of production is taking place. Increasingly networked, digitalized, and automated technologies are being used.

The developments in Industry 4.0 can be summarized in two core areas: Networking and self-control.

Networking describes the increasing communication between the various systems. Intelligent systems ensure that the most diverse machines, programs, or devices can work together and react to each other. This often happens even without any human intervention. This networking is also referred to as "cyber-physical production systems", as in some cases all systems in entire factories communicate with each other so that production can be completely automated. (Desouttertools, n. d.)

The second core of Industry 4.0 is self-control. This is a change from the type of machine control used in previous industrial revolutions. Previously, information was collected from the various machines and evaluated by humans. As a result, the human made adjustments to optimize the processes. With self-control, this happens differently. The machines no longer send their data to an IT system operated by humans. Instead, they have sensors, and the machines communicate with each other and improve the production process completely automatically. This self-control even takes place in more areas than just production. Various areas, such as sales, development or suppliers are involved here.

For example, if a machine runs out of a raw material, it automatically orders the right amount of a new raw material without the need for a human to be involved and check the process. (Raveling, J., 2020)

The distribution of information in Industry 4.0 is made possible by the Industrial Internet of Things (IIoT). This networks and connects machines in production with each other and emerged in the wake of the fourth industrial revolution as these smart devices are increasingly used. The IIoT consists of four core aspects.

An important component is cloud computing and big data. The data each machine collects is stored on a cloud that other machines can access. Since some of the networking must take place from a supplier located on the other side of the world, cloud systems are essential here. There must be a central storage location that can be accessed from anywhere.

The next important aspect is the previously mentioned "cyber-physical (production) systems". These are the main component. It is of enormous importance that every single machine involved in the production process is able to insert the data into a system and to execute the processes automatically. All machines must be able to perform their tasks autonomously so that autonomous production is possible at all.

This also includes machine learning and artificial intelligence. The machines must be able to think for themselves. For example, the machine must order new parts on its own, schedule maintenance times or work faster or slower and adjust to the other machines in the production or supply chain. The machine must be able to do this quite automatically, constantly adopting and adapting to changes.

The last important part is the interaction of the machines, i.e., the "Internet of Things" (IoT). (Boyce, H., Hallaq, B., Cunningham, J., Watson, T., 2018) (Sustainable Success, 2022)

In Industry 4.0, so-called "smart factories" emerged through networking and self-control and with the help of the IIoT. A smart factory is the ultimate goal or result of the conversion of a factory in the course of Industry 4.0. In a smart factory, everything organizes itself without or with hardly any human intervention. In a smart factory, all systems are networked, all machines are automated and everything communicates with each other via the IIoT. The production process is completely automatic. Humans are no longer involved in the production process. The only task that humans still have in a smart factory is that of monitoring. In a smart factory, it is even possible for production to take place at night, even when the lights are no longer on. In this case, even human observation and control is no longer required. (Bimos.com, n.d.) (Daniel, D., 2018)

2.1.3 The impact of Industry 4.0 on the car industry

The fourth industrial revolution is also playing a major role in the automotive industry. The automotive industry is currently undergoing a major upheaval due to Industry 4.0 and its effects.

Viewing the automotive industry from today's perspective, it can be divided in two areas: On the one hand, there are the classic automakers, which have been around for many years and some of which already played an important role in earlier industrial revolutions. On the other

hand, there are new automakers that have only emerged as a result of the conversions in Industry 4.0.

First, the traditional automakers are considered, and it is analyzed how the conversion to Industry 4.0 is proceeding for them.

Traditional automakers are investing heavily in new autonomous machines to optimize their production processes. However, this process took place very late with these automakers. While modern tech companies understood very quickly that their customers want new, modern tech devices and that the future is moving towards an even more digitally connected world, traditional automakers continued to build their traditional vehicles. So, for a long time, and to some extent still, nothing was controlled centrally in a vehicle, but there are many individual control units that control everything individually.

This was due to the fact that the classic car manufacturers still had good sales figures and did not really recognize the trend or did not take it seriously. The situation was similar in the production of these companies. Great importance was attached to giving the customer as many customizing options as possible. Each vehicle was almost unique.

While these large product portfolios are a good thing for the customer, it makes it difficult to create autonomous production. In Industry 4.0 and autonomous production in a smart factory, it is hardly possible to offer an endless number of customizing options, as this complicates the production process immensely.

Many automakers have nevertheless invested in smarter machines and networked them with each other. However, a crucial part has been forgotten. In order to fully implement Industry 4.0, a company must be prepared to completely change broader areas such as product offering, business model, manufacturing process and also customer experience. In this specific case, an automaker would have to significantly reduce its product portfolio and customizing capabilities.

Another issue that is a problem for classic carmakers is data storage, as well as digitalization. This needs to be improved immensely, as it lags far behind at traditional carmakers when compared to modern technology companies. One problem here, however, is that there is a shortage of skilled workers for these areas. For this reason, companies need to invest more in new skilled workers or continue to train existing workers.

In summary, traditional automotive manufacturers are already incorporating aspects of Industry 4.0, but this needs to be done on a much larger scale: Trends must be recognized earlier and adapted to, it must be recognized what the customer will want in the future, and qualified employees must be hired. (Deloitte Insights, 2020) (Sahay, S., Tiwari, A., n.d.)

The biggest threat to traditional car manufacturers are new tech companies. These companies were created at the time of the fourth

industrial revolution and therefore they only know the way of working and production as it works in the time of the Industry 4.0.

The tech companies then started to enter the automotive market and have fundamentally changed it.

Modern automakers have a very different approach. For example, they provide only a very small product portfolio, which simplifies production immensely. Their vehicles are also largely software based. Everything is controlled centrally in a single computing unit. All this makes production very simple and a factory in which such a vehicle is produced is much easier to operate autonomously. (Deloitte Insights, 2020) (Pal, U., 2020)

These new carmakers have an ever-increasing demand and are currently revolutionizing the car market. Their approach is completely different, and their production processes are also different. It can be seen that there are two completely diametrically opposed approaches to Industry 4.0 in the automotive sector and that the industry is therefore undergoing a huge upheaval.

2.2 Time-based competition

The following sections explain what time-based competition is and how it is linked to the Industry 4.0.

In an ever faster changing world, the industrial landscape is also changing at a rapid pace. Some companies recognized this early on and tried to take advantage of it. This gave rise to time-based competition.

Time-based competition means that companies try to gain a competitive advantage in which time plays a decisive role. The company tries to make the order-to-delivery process as compact and efficient as possible. This is noticeable for the company itself, but also for the customer. Time is seen as a resource in its own right, as important as cost, quality or inventory. However, time is not only seen as a resource, but also as the basis of a strategy. In time-based competition, companies react faster to market changes than their competitors. They also grow faster and are more profitable than their competitors. (Stalk, G., 1988)

This is possible if a company manages to establish organizational and structural changes in three key areas.

First, everything in manufacturing must run faster. Here the direct link to the fourth industrial revolution is highly visible. In-time production in smart factories is used. Just as in Industry 4.0, smart factories in which all processes are automated, and everything is networked also play an important role in time-based competition. Flexible factories mean that

fewer employees are needed to produce more products in less time. This creates an advantage which is referred to as time-based advantage.

The next optimization takes place in the Sales and Distribution area. It is of enormous importance to optimize this area as well, in order to prevent the advantages gained in manufacturing from being directly lost here. One way in which improvements can be made here is for a company to sell exactly what it produces. This saves on warehousing costs and also means that fewer employees have to be employed, which in turn means that the company has to spend less money.

Finally, the area of innovation and product development must also be considered. This also plays an important role in time-based competition. To gain an advantage here, a company must be able to shorten the time of the introduction cycle and product development. This is to bring the new products to the market faster. The company thus gains a time-based advantage, as it forces the competing companies to quickly develop competing products. If a company is always the first to launch a new product, it always has an advantage over its competitors. (Bcg.com, n. d.)

It can be seen that time-based competition has emerged from Industry 4.0. Time-based competition is a new type of competition that has arisen as a result of the changes brought about by the fourth industrial revolution.

2.3 Tesla's role in the EV industry

In the coming sections, the role of the car manufacturer Tesla in the automotive industry will be described. For this purpose, a rough overview of the Tesla company will be given first. This is followed by an explanation of why the company has a special role and why the company has taken on a pioneering role in the electric car industry.

2.3.1 Explanation of the company Tesla

The Tesla company was founded in 2003 under the name Tesla Motors by a group of engineers. Their goal was to show that electric cars could be better. They wanted to show that EVs can be faster, better and more fun to drive. Nowadays, Tesla doesn't just produce EVs, nor does it see itself as a pure car manufacturer. The company also offers clean energy solutions, battery storage products and also develops AI software. Tesla's mission is to accelerate the world's transition to sustainable energy. (Tesla.com, n. d.)

Tesla started in 2006 with the introduction of the Tesla Roadster, which went into production in 2008. This car was a converted Lotus. Tesla bought the cars from Lotus and converted it to be fully electric. A battery pack was used, and the engine was changed and replaced with electric motors. The Tesla Roadster was the first all-electric vehicle to satisfy customers. The car had a range of up to 483km and the acceleration and top speed were comparable to sports cars at that time. However, with a price point of around \$100,000, the Tesla Roadster was more of a luxury vehicle and not affordable for the masses. Another point of criticism were the long charging times of 24 to 48 hours, which made it difficult to move the vehicle daily on long distances. (Reed, E., 2020)

In 2008 Tesla planned to release the Model S and showed a prototype for the first time in 2011. The vehicle was supposed to be more affordable at \$75,000. The Tesla Model S is a sedan with room for up to 5 adults and 2 children. The vehicle went into production in 2012 and was produced in much higher numbers than the Tesla Roadster. It was Tesla's first step into mass production. The car received a lot of positive reviews, it had high customer satisfaction and received many awards. In addition, Tesla was able to maintain the range of up to 482km and the charging time was drastically improved by the introduction of fast charging. (Britannica, n. d.)

Tesla opened the Supercharger network in 2012 in this regard. This is a network of fast charging stations where only Tesla vehicles can do fast-charging. Here it is possible to fully charge your Tesla in about 30 min. The Superchargers are located at strategic points, such as highways or freeways. The purpose of the Supercharger is to be able to quickly recharge the Tesla on long distances. This network is still being expanded today and new Supercharger locations are being built around the world. In 2013, Tesla opened the first Gigafactory in Nevada. The Gigafactory is a large factory where Tesla produces its batteries. Today, the Gigafactory produces more lithium-ion batteries than all other factories in the world combined. Later, other Gigafactories followed in the USA, Germany and China in which Tesla produces its batteries, but also the vehicles.

In 2015, Tesla then brought out the Model X. This is an SUV based on the Model S with room for up to 7 adults. The Model X now adds an SUV to the lineup of just a sedan.

In 2016, Tesla introduced the Model 3 and launched it in 2017. The Model 3 is a smaller sedan, which will be offered for the first time at a much lower price of \$39,000. This makes it very affordable and competes in price with internal combustion vehicles in the same vehicle class. However, Tesla suffered something with the Model 3 that Elon Musk, the CEO of Tesla called "production hell". There were massive problems in the production of the vehicle that were related to the supply chain. Parts had to be sourced from all over the world, causing massive delays. As a

result, Tesla ran into financial difficulties, which were, however, solved through investments. (Tesla.com, n. d.)

In 2017, Tesla changed its name from Tesla Motors to Tesla, Inc. as the company wanted to specialize not only in the production of vehicles, but also in the production of battery packs and solar panels.

Tesla's last vehicle to date followed in 2019 and was launched in 2020. The Model Y is a larger version of the Model 3, which shares many common parts and components. It's a bit more expensive, but as a small SUV, it's once again priced comparably to other internal combustion vehicles in this class. (Reed, E., 2020)

Tesla has introduced other products in 2017 and 2019, but to date they are not yet ready for the market.

In 2017, the Tesla Roadster, a sports car designed to outperform all existing current sports cars, was unveiled. Likewise, in 2017, the Tesla Semi, a full-electric truck was announced. This was followed in 2019 by the unveiling of the Cybertruck, which is a futuristic pick-up truck. Then in 2021, Tesla introduced the Tesla Bot, a humanoid robot with an AI to help in everyday life or in production.

Another important aspect at Tesla is the development of their advanced software systems, most notably Full Self Driving. Every Tesla vehicle is equipped with an advanced camera system that provides the capability for fully autonomous driving. Tesla is constantly developing this system and already offers a beta program in which Teslas can drive fully autonomously.

Likewise, the demand for Tesla vehicles is increasing so much that Tesla is constantly raising prices and pushing delivery times very far back. The earliest you can get a Tesla Model X today (April 2022) is January 2023. This immense demand currently gives Tesla a role as a leader in the electric car market. (Reed, E., 2020)) (Britannica (n. d.) (Tesla.com, n. d.)

2.3.2 Tesla's key advantages

The Tesla company has significantly changed the car industry. Tesla was the first company to successfully launch electric cars and produce them in large numbers. Because of Tesla, many other companies have also started to produce electric cars.

In the following, we will look at how exactly Tesla managed to revolutionize the market and what the company did differently than other car manufacturers.

Tesla's business model is built on a three-pronged process: Selling the vehicles, servicing the vehicles, and charging the EVs.

When it comes to sales, Tesla was the first automaker to choose direct sales. The common practice was actually to sell vehicles through dealers,

meaning in car dealerships that offered all sorts of different vehicles. These dealerships then received a commission for helping with the sales process. Tesla has bypassed this system by selling its products directly. Thus, Tesla sells the majority of its vehicles online through its website without involving any middleman. In addition, there are Tesla stores, which are mostly located in urban areas. There, however, only Teslas are offered for sale and the employees are very familiar with these vehicles. Also, Tesla does not charge a commission for the advice. The price in a Tesla sales outlet and online is exactly the same. Through this direct sale, Tesla speeds up the sales process immensely.

The next step is servicing the vehicles. Here, Tesla has built up a network of Tesla Service Centers that function like a conventional workshop. In addition, there is the mobile Tesla Service, which comes to the customer's home and repairs the vehicle on site.

However, Tesla has the decisive advantage that the vehicles are strongly software-based. This makes it possible to detect or even eliminate errors over the air. In most cases, a visit to a service center is not even necessary for error analysis. This makes it easier for customers to service their vehicles. The customer experience is significantly improved, especially compared to traditional car manufacturers, where a visit to the workshop is essential in case of a problem.

Finally, there is the Tesla Supercharger network, a worldwide fast charging network where a Tesla can be fully charged in a short time. Through this, Tesla has managed to increase the adoption rate of electric vehicles and improve the customer experience. The Superchargers have made it much cheaper and easier to move an electric vehicle, even over long distances. Of course, there are also charging networks from other manufacturers. However, Tesla's Supercharger network is still the gold standard. The Supercharger has the highest reliability, the most user-friendly operation, a competitive price and it is the fastest growing charging network.

Many see Tesla as more of a tech company than an automaker because of its modern approach and the way the company has reshaped the auto industry. Tesla has many similarities to modern tech companies.

For example, the company always has a modern approach and adapts quickly, responds quickly to customer needs, and acts like a modern tech company in this area. Below are a few examples:

Sentry mode is a surveillance mode, with which the owner can observe the area around his parked Tesla. Through the extensive camera system, Sentry-Mode records everything that happens around the vehicle to record vandalism, theft or similar happenings around the vehicle.

Dog mode is a mode that can be activated in the vehicle when a dog is left alone there. The vehicle cools or heats the interior to a comfortable

temperature and a message appears on the screen saying that the owner will be right back, and the temperature is comfortable for the dog inside. With the Bioweapon Defense Mode, the Tesla ensures that the air in the interior is cleaned with its strong air filter. This mode is intended for areas where there is a high level of air pollution.

Furthermore, every Tesla nowadays has YouTube and Netflix, so the owner can watch videos during charging breaks. In general, operating a Tesla works more like operating a smartphone or tablet rather than a car. Tesla added most of the above listed features through an over-the-air update. This approach of bringing out new features in response to customer requests and then installing them over-the-air in the car at no additional cost really sets Tesla apart from the competition and makes the company seem more like a modern tech company.

Other similarities to modern tech companies can be seen in Tesla's innovative and playful approach to naming. Where sport modes in classic cars are just called "Sport" or "Sport+," Tesla names them differently: "Insane Mode" or "Ludicrous Mode" are examples that show Tesla's ingenuity and their looseness.

Likewise, Tesla has a hype that is unique in the auto industry. Tesla has a loyal fan base that is more comparable to Apple's than to any other car manufacturer.

Lastly, Tesla is developing the Full-Self-Driving System and is also a pioneer in this field. Tesla vehicles are equipped with advanced camera systems and every Tesla has the Autopilot. This offers much more than simple cruise control or lane keeping functions. Tesla's Autopilot is based on a AI system that is continuously learning and improving. In the meantime, this system can drive autonomously (in a beta program). With this system, Tesla has a significant lead over the competition, as the AI has already been fed with data for about 10 years. This amount of data gives Tesla an unassailable lead over the competition, who do not have this data available.

It is clear that Tesla stands out from the competition and does a lot of things differently. The general approach of how the company came to market, the willingness to change the entire business model, but also the vehicles themselves, which are more like a tech device, clearly set Tesla apart from the competition and make the company a unique vehicle manufacturer changing the whole car industry. (Morris, C., 2021.) (Zucchi, C., 2022) (Hardman, S., Shiu, E., Steinberger-Wilckens, R., 2015)

3 METHODOLOGY

In this thesis, the qualitative research approach is used. Non-numerical data is collected and then analyzed. The approach is used to understand

a concept. It is used to provide deep insights into a problem or an issue and to develop new ideas.

Furthermore, the method of the secondary research is used in this thesis. Existing data is collected and analyzed. These data are first prepared and organized. Then reviewed and sifted. After that, the concepts that are to be used are created. (Bhandari, P., 2022)

The next step is to apply the principle of qualitative case study. The qualitative case study is a research methodology that helps an exploration of a phenomenon in some particular context for various data sources and undertakes the expiration throughout variety of lenses in order to reveal multiple facets of the phenomenon. (Baxter & Jack, 2008)

In a qualitative case study, a specific situation is examined in depth. In doing so, what is actually a very broad field of research is narrowed down to a topic that is easy to explore. This allows for further and detailed elaboration of the topic and allows for hypotheses to be generated. The qualitative case study provides more realistic answers to the research question than a mere statistical survey, as it sheds light on far more points. In addition, it provides new results and is more flexible than a simple data collection. Here, a large area is intentionally isolated and only a small part is illuminated in detail. In the data analysis of a qualitative case study, more opinions and recommendations are given instead of concrete numbers. (Baxter & Jack, 2008)

In the course of the thesis two additional methods are applied. Firstly, the competitors will be examined by means of a SWOT analysis. The goal of this is to analyze the strengths, weaknesses, opportunities, and threats of these companies and contrast them to Tesla to see how the companies stand in the market.

Furthermore, a VRIO analysis is performed. The goal of this is to give a detailed internal analysis of Tesla to work out all competitive advantages and classify them accordingly. In the VRIO analysis, various internal aspects of a company are examined and it is analyzed in which specific areas the company has an advantage over its competitors and how large this advantage is.

4 RESULTS

4.1 Competitor analysis

In the following sections, a SWOT analysis will be performed. For this purpose, first a general overview of the companies that are compared is given and it is explained why exactly these companies are taken as

examples and compared to Tesla. This is followed by a SWOT analysis of Volkswagen and Lucid.

4.1.1 General overview

SWOT-analysis is a framework that is used to determine the company's position in the market as well as it is a useful tool for developing the company's development strategy. SWOT analyses provides both internal and external factors that affect the company in question. It is supposed to help the managers in evaluating market positioning, current and future potential and setting a realistic look at the organization's positive and negative sides. SWOT is an abbreviation for Strengths, Weaknesses, Opportunities and Threats, and those are internal and external factors of the subject in question's operations.

The reason why certain companies such as Volkswagen and Lucid were chosen for this analysis is that Volkswagen is a good example for a traditional company. Volkswagen is a market leader, operating since 1937.

Comparing Tesla with this kind of company would highlight Tesla's innovative approach and the way how the company makes the best of it. It shows the differences of a modern operating startup and a traditional brand that exists and operates for many years already.

Lucid, on the other hand, is relatively new on the market just as Tesla is, and yet two companies' methods of operating regarding their supply chains are different. The purpose of the comparison was to show the drastic difference between the ways how traditional and younger companies operate. Besides, to highlight Tesla's expertise in regard to building sustainable supply chains.

4.1.2 Analysis of Volkswagen

The Volkswagen company was founded in 1937, making it one of the traditional car manufacturers that have been producing vehicles for many years. The Volkswagen Group consists of several European vehicle manufacturers: Volkswagen, Volkswagen Commercial Vehicles, ŠKODA, SEAT, CUPRA, Audi, Lamborghini, Bentley, Porsche and Ducati. Currently, Volkswagen is the second largest vehicle manufacturer. (Volkswagen AG 1, n.d.) (Volkswagen AG 2, n. d.)

Strengths

As already mentioned, the Volkswagen Group is currently the second largest vehicle manufacturer in the world. This is one of the strengths of the company. Due to the high sales volume, the company is not only financially stable. It also has continuously good sales and a solid customer base. In 2019, the company sold 10.9 million vehicles.

The company is also in a strong financial position. According to Forbes, the company ranked as follows in May 2020: 8th in sales revenue, 37th in profitability, 70th in terms of assets, and 133rd in terms of market value. This puts the company in a more financially stable position than any startup, as Tesla was when it began. (Forbes, 2022)

The company has also built up a strong recognition value over the years. The logo, as well as the name, are known worldwide and it is one of the best known companies in the world. This is a status that usually takes a company many years to acquire.

Another decisive advantage that Volkswagen possesses is the satisfaction of its employees. This is also rooted in the group's long history. According to Forbes, Volkswagen was ranked 31st on the "World's best employer" list in 2019.

Volkswagen's large product portfolio, which ranges from affordable small cars to luxurious supercars is another advantage of the company. With even motorcycle and truck manufacturers, the company is very diversified.

With 124 production locations, VW has another advantage in that the company has a global presence and can therefore operate globally. This is another big difference to a relatively new company like Tesla, which has to build up this global network first. (Business Strategy Hub, 2020) (Jurevicius, O., 2021)

A look into the future reveals another strength of the VW Group. With its "Together 2025" strategy, the company has set ambitious goals with which it wants to counteract the emissions scandal. In the "Together 2025" strategy, the company wants to bring 30 new all-electric vehicles to market by 2025. This is part of the electrification of the company's fleet. Likewise, the company wants to develop new competencies in battery development, digitalization and autonomous driving. Lastly, the budget for the research and development area will be increased many times over. This "Together 2025" strategy shows that the Volkswagen Group knows exactly where its weaknesses lie and that the competition from companies like Tesla is putting pressure on it. Volkswagen has recognized this and is precisely tackling these areas. (Volkswagen AG 3, n.d.)

Weaknesses

Probably the greatest weakness of the Volkswagen Group is the emissions scandal that recently affected the company. In 2015, it emerged that the emissions values had been exceeded many times over. VW had manipulated the measured values so that the vehicles had lower CO2 emissions on paper. This led to the company receiving massive negative

publicity. A huge loss of image and trust in the group has massively weakened the company. On top of that, the company had to compensate many of those affected, as they filed lawsuits against the corporation. (Environmental defence, n.d.)

Another weakness of the group is that it has not managed to adapt perfectly to the latest generation, Gen Z. Younger people no longer care about owning a car themselves. They are increasingly turning to rideshare, car share or even car rental offers. The Volkswagen Group offers relatively little in this area, making it difficult for it to reach the new generation of customers. Another problem is that VW has never managed to create anything like the hype that Tesla has around the VW brand. This makes the brand seem rather uninteresting, especially for young people.

According to a study by isecars.com, Volkswagen has a recall rate of 1,805 per 1,000 vehicles produced. This is clearly another weakness of the group. Quality control needs to be improved here, as these recalls cost the company a lot of money. (Lee, T., n. d.)

Last but not least, the Volkswagen Group has another major weakness that sets it apart from modern companies like Tesla. Volkswagen currently has little expertise and knowledge on how to manufacture battery-powered vehicles. Volkswagen is still far behind the market leader Tesla in this area, which could be a big problem especially in the future, as the trend is clearly moving towards electric cars, which Volkswagen itself has already recognized. (Posana, J., 2021)

Opportunities

Volkswagen has already put its focus strongly on electric vehicles, as well as smaller vehicles. The focus is strongly moving away from pick-up trucks or vehicles with a strong and big engine, which needs a lot of gas. This is a good opportunity, as rising fuel prices are strongly boosting sales of these fuel-efficient vehicles and helping to sell more of them. Demand for electric vehicles also increases sharply when gas prices rise.

Another opportunity is that Volkswagen has is to acquire new smaller startups that have the necessary skills Volkswagen lacks. As there are currently many start-ups specializing in battery production, digitalization or autonomous driving, this is a good opportunity for the Volkswagen Group to buy them up and become successful as part of the "Together 2025" strategy.

The demand for autonomous vehicles is growing strongly. According to analysts, autonomous vehicles are becoming "the next big thing." This is an opportunity for the Volkswagen Group to be one of the first on the market to launch such a system. VW has planned to introduce

autonomous vehicles in 2025, which would make the company one of the first with autonomous vehicles on the market in terms of time.

Another big opportunity that Volkswagen owes in some part to Tesla is the trend toward environmentally friendly vehicles. Here, too, the company's strategy of fully electric or fuel-efficient vehicles offers another great opportunity to sell even more cars in the future.

Threats

The before mentioned emissions scandal still poses a major threat to the Volkswagen Group. The company is constantly losing money due to several lawsuits in various countries, which are still ongoing and in which a final verdict has not yet been reached. The company has already had to pay some penalties and compensate customers in the past.

Probably the biggest threat to the company comes from the increasing competition and the restructuring of the market. Modern companies, such as Tesla, have taken a completely new approach and shaped the entire auto industry. With their vehicles being more of a computer on wheels than a traditional car, a major threat is emerging for traditional car manufacturers, such as Volkswagen for the first time, which has never happened before. The company must rethink its entire market strategy, as well as its manufacturing process. Suddenly, things like digitization, autonomous driving and battery production are an issue that were never relevant before. This is a major threat to Volkswagen, as it needs to adjust its entire strategy and shift its focus. (Posana, J., 2021)

Along with the change of the car industry, there are also many new government regulations. Many governments are following the trend of the auto industry and legislating how much CO₂ emissions a vehicle can emit. Many governments have also already decided to stop the sale of combustion vehicles for a certain year. This puts the Volkswagen Group under pressure, as the company can now not only produce electric cars, but even has to in order to ensure its survival. The company will be forced to produce electric vehicles and to change its production completely, since the combustion vehicles may no longer be sold after a certain date.

4.1.3 Analysis of Lucid Motors

Lucid Motors is a US company that was founded in 2007. As such, this company provides a typical example of a modern, new startup company in the automotive market. The company initially produced batteries and electric drivetrains for other carmakers under the name Atieva. Then in 2014, the company began developing its own car and renamed itself Lucid Motors in 2016. In 2016, the company also introduced the Lucid Air. This only car of the company has been on sale since 2021.

Strengths

The company Lucid Motors has its greatest strength in its combination of being a modern company, which can score points similar to Tesla with its modern approach to act like a tech company and on the other hand, the company can look back on many years of experience. The company has been producing electric drives and batteries for many years, which are used in Formula E racing cars, among others. Therefore, Lucid Motors has a state-of-the art battery technology. (Ramer, L., 2021)

In addition, the company has a large number of investors who constantly bring money into the company and ensure its survival. This steady source of money makes the company very stable financially. (Donati, A., 2022) (Dealroom.co, n. d.)

In addition, Lucid can also score points with its only vehicle, the Lucid Air. It has a range of over 800km and is even cheaper than its direct competitor, the Tesla Model S. The Lucid Air also scores very well in reviews. The vehicle has a very high customer satisfaction rating. In the Motortrend magazine, the Lucid Air won the Vehicle of the Year award. (Markus, F., 2021) (Ramer, L., 2021)

Weaknesses

Probably the biggest weakness Lucid has is that the company is currently falling short of expectations. Lucid Motors planned to sell 20,000 vehicles in 2022. However, the company revised this target downward again at the beginning of 2022 and currently plans to produce 12,000 to 14,000 vehicles. The company cites problems in the supply chain as the reason for this. As a result, the company is disappointing investors.

Another weakness of the company is the few pre-orders it had at the beginning. These were far behind those of Tesla or other competing electric cars.

Lucid Motors has also been slow to deliver, as the company has faced major teething problems. By early 2022, the company had delivered only 300 vehicles, also falling short of expectations. (Ewing, J., 2022)

Opportunities and Threats

On the Opportunities and Threats side, Lucid Motors also has a few aspects.

Probably the biggest opportunity is that the company is entering an emerging market. The electric car market is growing steadily, and the demand is huge. Lucid Motors is therefore right on time and can fully exploit its potential here.

Another opportunity is to attract more large investors. Lucid Motors has already managed to attract many investors for their projects. With higher

sales, more models on the market and continued good customer satisfaction, it is very possible to attract more investors to the company.

On the Threats side, the biggest threat to the company is the strong competition. Not only Tesla, which started like Lucid, is a direct competitor. Other EV startups, as well as traditional automakers such as Volkswagen, also pose a major threat to Lucid. The company has to prove itself in a highly competitive market.

Another danger for the company is the phase it is currently in. As a start-up, Lucid Motors is dependent on investors. If they jump ship and decide not to provide any more money, Lucid Motors runs the risk of going bankrupt, as there are no more funds available.

4.2 Comparison of supply chains

In the following section, the supply chains of the companies mentioned above will be analyzed. First, the supply chain of Tesla will be analyzed, followed by the supply chains of the Volkswagen Group and Lucid Motors. In particular, the aspects of ... will be discussed. Finally, the similarities and differences between the supply chains are highlighted.

4.2.1 Tesla's supply chain

Tesla's never-ending research and development results in cutting-edge technology-powered innovations. The organization is a great example of how innovative automotive technologies can improve the efficiency and safety of automobiles nowadays. In real-time mode, the company is changing the way whole automotive sector worked for decades. Currently, Tesla filed more than 350 patents regarding innovative technologies that they have developed. (Tesla 1, 2021)

When building vehicles, automakers like Tesla use automation, machine learning, artificial intelligence, and other technology, including creative accessory feature comparisons like flow formed vs forged wheels (Supply Chain Game Changer, 2018). It is widely recognized that Tesla's achievements in the automobile industry are noteworthy. However, as any other automaker, Tesla faces a number of challenges, including those that are related to supply chain management. (Rivero, 2022) Nevertheless, it seems that the company is able to tackle those issues unlike their competitors.

The key for the solution to these problems is Tesla's effective supply chain management strategy, that was changed just recently after a long string of public production delays, safety and quality issues. (Markoff, 2022) According to their strategy, the company monitor compliance with sustainability conditions at every stage of the supply chain, rely only on itself in the production of crucial parts, influence the local communities

in which it purchases materials and also recycles and reuses its products. (Tesla 2, 2021)

When purchasing the parts for their cars, Tesla prioritizes the protection of human rights and environment. Some of the materials and companies needed for production of Tesla's cars are purchased from their direct suppliers. Nowadays, Tesla has over 350 suppliers from all over the world providing the company with more than 3000 parts. Many of their direct suppliers receive those raw materials from their sub-suppliers: This leads to a complex supply chain. (Tesla 2, 2021)

Tesla sees as their mission to contribute in the world's transition in regard to adopting sustainable energy. (Tesla, 2014). For that, Tesla is ensuring that all their suppliers act with respect to human rights and protection of the environment. This is accomplished by proactively identifying and mitigating potential supply chain issues. Tesla's standards for suppliers are outlined in three documents which are the Human Rights Policy, the Supplier Code of Conduct, and Responsible Materials Policy. (Tesla 3, 2021) The basic components needed come from Tesla suppliers from all over the world, especially the U.S., Europe, and Asia. (Maverick, 2022) They aim to create a system in which Tesla's supply chain affects local conditions for stakeholders positively, improving their standards of living as a result of the company's activity. Based on the OECD Due Diligence Guidance for Responsible Mineral Supply Chains, the company developed the strategy how to source responsibly. Firstly, it is done by increasing the amount of supplies that they get from suppliers directly, especially from those which are located closer to their manufactures. Secondly, by continuing purchasing the materials from all over the world therefore impacting the living conditions of local communities. (Tesla 2, 2021)

Besides, Tesla's responsible sourcing program related also to three most important minerals for battery production: nickel, cobalt and lithium. (Tesla 4, 2021) They are important, first of all, from commercial standpoint, as they are the major raw elements utilized in cathode manufacture, which account for about a third of the overall cost of a battery cell and play a critical role in increasing vehicle range and safety. Secondly, from environmental and social impact points of view as well. The reason for this is that those minerals are mined in various ways around the world, with a concentration in regions facing socio-economic and environmental issues. (Tesla 2, 2021) These minerals are becoming increasingly scarce as known worldwide deposits are depleted, and corporations are looking for resources in more remote and difficult regions to supply global demand. Besides, as a basic necessity for moving away from fossil fuels and toward a low-carbon economy, these minerals are recognized as the most important by authorities from the US, EU and Canada. As a result, the impact of mining operations on the environment and local communities is being scrutinized more closely by civil society, governments, and investors.

Nowadays, the company creates recyclable batteries therefore trying to build a closed loop supply chain in order to reduce their relying on mined

materials. This is beneficial from both environmental and business points of views. The reason for this is that unlike fossil fuels, Tesla's lithium-ion batteries can be repeatedly recycled, which, in turn, reduces the negative impact on the environment. At the same time, it is cost-saving as less money has to be spent on raw materials. Tesla's engineers are trying to extend useful life of each battery package, for example, by developing software updates for Tesla vehicles for improving battery efficiency. Moreover, any battery that their client is not satisfied with, can be serviced at Tesla Service Center. (Tesla 2, 2021)

Another step towards sustainable supply chain is that Tesla is trying to implement in-house recycling. For that, they installed their first recycling facility in the company's fabric in Nevada. Previously, they worked with third-party recyclers with ensuring the quality of recycling. However, as time passes, the company's management came to conclusion that own recycling capacity is important to support existing partnerships with suppliers. This is because on-site recycling moves Tesla closer to closing the materials generation loop, which was the company's initial goal, allowing them to send raw materials directly to the nickel and cobalt suppliers. The facility breaks the cycle of innovation for battery recycling at scale, allowing Tesla to enhance current designs quickly through operational learnings and conduct R&D product process testing. (Nedelea, 2021) The aim is, with the developing of safe on-site recycling system, to optimize the use of valuable components therefore lowering environmental impact and save costs in the long run.

To follow OECD guidelines, Tesla source directly from miners. For the company, it makes supply chains more transparent and traceable and besides that, improves environmental and social statistics. Recently, Tesla for the first time in the company's history disclosed a list of direct battery material suppliers, as well as confirmed that it has a long-term nickel arrangement with Vale company, the world's largest nickel producer. (Lambert, 2022) According to that list, the most important Tesla's suppliers are: BHP, Ganfeng Lithium Co., Glencore, Modine Manufacturing Co., Rohm And Haas Company, etc. Tesla have developed close relationships with those several key suppliers particularly in the procurement of cells and certain other key system parts. While they obtain components from multiple sources whenever possible, similar to other automobile manufacturers, many of the components used in their vehicles are purchased by the company from a single source. (Backspace, n.d.). This allows the company to secure long-term contracts and ensure the flow of batteries years ahead.

In addition, Tesla intends to contribute to the continual improvement of conditions in communities affected by Tesla's supply chain operations, based on direct supplier interaction and consultation with local experts, community organizations, and civil society. (Tesla 3, 2021)

As for their factories, Tesla has four fully functioning facilities at the moment. Three of them are in the United States, while the fourth is located in China, Shanghai. (Doll, 2021)

The Fremont factory, located very close to San Francisco, is the origin of Tesla's electric vehicle manufacturing. On 370 acres of land, it now accommodates over 10,000 Tesla employees and offers 5.3 million square feet of space. Tesla continues to manufacture all the existing models of their cars there, as well as the majority of their components needed. While Tesla receives parts from suppliers from all around the world, several of their suppliers have constructed local operations in order to be closer to the Tesla production.

Next after Fremont factory, Gigafactory 1 was built, and it is located in Sparks, Nevada, just outside of Reno. For the Model 3 car, this Gigafactory produces electric motors and lithium-ion battery packs. It also produces Tesla's energy storage devices, including the Powerwall and Powerpack, which it inherited from the Fremont facility in 2015. Besides, first Tesla's recycling facility is located there.

Then in chronological order was Gigafactory 2 – Giga New York. Unlike other factories, this facility focuses primarily on solar energy instead of producing electric vehicles. Tesla started producing solar cells and modules in 2017 there, and then developed additional production lines for electrical components for Supercharger and energy storage products in 2019.

The Gigafactory in Shanghai is the second to assemble actual Tesla vehicles. The Model 3 final assembly and Model Y production are now taking place at this 9.3 million square foot Gigafactory.

According to Tesla, most of their cars are manufactured now in California and Shanghai. (Kane, 2022) Two more Gigafactories in Texas and Berlin came on line in early 2022, producing the Tesla Model Y to meet the huge demand for this vehicle.

Tesla's thoughtful supply chain management allowed the company to overcome crisis moments, such as a lack of semiconductors in the market, coronavirus pandemic, an economic decline, without significant losses, what other car manufacturers were not able to do. Their supply chain strategy includes caring for the environment, respecting human rights, trying to positively influence the life's of local communities which are touched by Tesla's supply chain. Moreover, they could avoid the consequences of the global chip shortage as Tesla created in-house competence to write the software code that controls its cars, just as it insisted on controlling its battery supply chain when it constructed the Gigafactory in Nevada, whereas its competitors depended on vendors for this expertise. Despite the fact that it expanded Tesla's core competency scope and was more expensive, this decision allowed the business to update its software code to accommodate and work with whatever chips it could obtain. Tesla's software management and agility provides them with the natural flexibility to switch vendors and semiconductors as needed. Because of its familiarity with the design and software of its onboard computers, it decided to standardize chips so that each car

would have fewer chip SKUs to acquire. (Markoff, 2022) Finally, the company is trying to do as much as possible “in-house”. This includes manufacturing basic necessities such as the electric motor, battery pack, charger, and now recycling of those.

4.2.2 Competitor’s supply chains

In the following, the supply chains of the two selected competitors of Tesla are analyzed. On the one hand the supply chain of the traditional manufacturer Volkswagen and on the other hand the supply chain of the new startup Lucid Motors.

4.2.2.1. Volkswagen supply chain

Volkswagen takes environmental protection and quality assurance seriously. All raw materials that end up as components must travel through approximately 15,000 stations during the production, treatment, finishing, and transportation in a Volkswagen company. Thousands of suppliers work with the organization, all of whom take great care to ensure that the complex purchasing process is ecologically friendly. Volkswagen works with suppliers that are able to provide them with high-quality and long-lasting products that meet the brand's criteria. The conservation of resources is what Volkswagen aims for. For that, they focus on obtaining and utilizing sustainable resources. Whenever is possible, company uses renewable raw materials whenever available with the aim of reducing CO2 emissions throughout the lifecycle of its vehicles. (Marcello) Cotton, hemp, flax, cellulose, and kenaf are among the environmentally friendly materials used. The door trim of the Golf is made with the fine fibers of the kenaf, a tropical plant. (Gorshkov, 2020) Renewable raw materials are used for the trunk linings, armrests, hood insulation, floor insulation, and panel trim. Recycles, or secondary raw materials, are materials generated from waste or by-products of the production process and are used by Volkswagen. The company buys recycled plastics to make floor coverings, spare wheel compartment covers, and wheel arch inserts. (Bogdanor, 2017)

Although aluminum is more energy-intensive to produce than steel, it is vital in the automotive sector for the production of lightweight designs. Audi is attempting to address this issue by establishing the Aluminum Closed Loop prototype, an innovative recycling project. The initiative's purpose is to develop a more effective way to recycle aluminum by creating a closed-loop system between Volkswagen and the company’s suppliers. (Schiele, 2019) VW used to send its aluminum cuts to outside melting contractors, who subsequently sold the metal to VW, which was then melted at the VW factory. All engines, body parts, and transmissions are now produced at the Volkswagen facility in Kassel. Because the plant's procedures include metal machining, such as milling, grinding, and

drilling, large volumes of aluminum are produced as well (Weckenborg, 2022).

Suppliers including Nemak S.S., Harting Automobile GmbH, Friedrich Boysen GmbH, and SIEM Car Carriers AS play vital role in the company's performance since they are known as the ones that are able to deliver orders on time. Volkswagen produces high-quality automobiles using remanufactured materials, saving consumers money and helping the environment.

Nowadays, Volkswagen is recycling a variety of their cars' parts, including transmissions, engines, and electronic systems. Volkswagen Genuine is the brand name for the recycled products that were produced. Parts that have been recycled are then tested and utilised in other vehicles (Bogdanor, 2017). This way, the company saves a lot of money while delivering high-quality goods.

Conducting a material flow analysis is crucial for the manufacturing process. The company employs material flow analysis to get more insight into their global manufacturing operations. Some areas of international companies may be disregarded, resulting in increased expenses and squandered resources. VW is aware of this and conducts inspections on a regular basis. (Veile, 2020)

Volkswagen collaborates with a diverse group of suppliers and operates in a complex supply chain. VW has been squeezing its margins as a result of the ever-increasing need to make automobiles as affordable as possible to as many customers as feasible. (Veile, 2020)

As a result, the corporation turns to supplier relationship management to develop a holistic approach to controlling the supplies it requires.

There are especially important for Volkswagen areas, such as distribution, R&D, production, marketing, and sales. For successful operations in those areas, Volkswagen builds strategic alliances with its suppliers that focusing on those. Strategic alliances take time to develop, but once created, they are tremendously valuable to all parties involved. VW and its suppliers benefit by cooperating with other companies in a variety of ways, including lower costs of possession, procurement, and distribution of goods and services. VW forms alliances with a variety of significant suppliers who share some of the responsibility for guaranteeing the brand's success in providing high-quality products to its customers.

Strategic partnerships are the most common type of hybrid organization because they improve collaboration between firms while also improving supply chain operational efficiency. (Jain, 2019) Product dispersion without having to deal with the costs of having a physical presence in the market, reduced coordination and transaction costs, and risk and reward sharing were all alternatives provided to VW and its partners as a result of the agreements.

The Volkswagen Group makes extensive use of global outsourcing as well as a comprehensive internal component division. The Volkswagen Group skillfully manages its buyer-supplier relationships to ensure that all

parties benefit from their respective operations. Its long-term partnerships result in a lucrative bottom line. As a result of its established buyer-supplier relationship, Volkswagen enjoys lower expenses. Dealing with new suppliers can be very costly; consequently, these partnerships are critical for avoiding unnecessary costs. The company saves money in the long run through forming mutually beneficial relationships with key suppliers. Good working relationships also help to reduce delays, availability issues, and quality issues, ensuring that customers obtain the best service possible (Jääskeläinen, 2021). Volkswagen has built effective communication to guarantee that suppliers understand and can appropriately satisfy their business needs. Furthermore, when challenges arise during the ordering process, a positive buyer-supplier connection makes it easier to resolve these concerns.

In order to ensure that all parties involved have a thorough understanding of each other's internal processes, different sectors of the buyer's and supplier's businesses collaborate. The company's suppliers, for example, modify portions of the company's working activities to meet their own needs and gain operational savings and advantages (Veile, 2020). Buyers can reduce the number of suppliers they engage with thanks to the company's supply chain consolidation, which streamlines the purchase process and makes budgeting easier.

VW and its suppliers have developed a trustworthy relationship as a result of their successful buyer-supplier relationship. As a result, several key functions are permanently outsourced to VW suppliers. In terms of inventory management and other industrial processes, this necessitates the company developing confidence with its suppliers. VW's strategic connections allowed the company to quickly resume production after one of its partners was forced to shut down because of the COVID-19 epidemic. Jiangsu Pacific Precision Forging took over production and guaranteed that VW's supply chain was maintained, allowing the brand to quickly resume production. The company's primary suppliers are all critical components of VW's global production since they are innovative brands that provide products quickly.

Volkswagen has a diverse portfolio that it is constantly expanding in order to keep up with its competitors. The organization places a high priority on innovation and works with suppliers who share those ideals. To ensure that it creates sustainable automobiles, it partners with suppliers who value research and innovation. The company strives to reduce carbon emissions and collaborates with suppliers who assist in this effort. By supplying charging cables and battery containers, Harting and Nemak played a critical part in VW's e-mobility vehicles (Volkswagen, n.d.)

At present, Volkswagen produces millions of vehicles all around the world yearly. To the year of 2021, Group's production network had 118 locations worldwide, with 70 plants producing automobiles at a rate of roughly 40,000 units per day. With 49 manufacturing units for vehicles and components, the Volkswagen brand is a firm foundation in this global network.

The "Production and Logistics" branch of the Volkswagen Passenger Cars brand is responsible for 15 of the 49 facilities, and that is not including China. The production line there produces well-known cars including Volkswagen the Golf, Tiguan, Touareg, Passat, and the new all-electric ID series. The two joint ventures FAW-Volkswagen and SAIC Volkswagen run the factories in China. ("Production and locations | Volkswagen Newsroom")

Many of the sites also produce components such as engines, transmissions, batteries, and steering systems. Volkswagen Group Components, which has been a separate business unit managed by Volkswagen AG since the beginning of 2019, is responsible for these production sectors.

The automotive industry as a whole is undergoing a major change towards electromobility. The transition at Volkswagen is already well underway. For achieving success in that, Volkswagen is managing and growing their unique and worldwide production network. The main challenges in ensuring a smooth operation are growing productivity, sustainability, and digitalization – for instance in areas like big data, 3D printing, and smart networking (Volkswagen, n.d.).

4.2.2.2. Lucid Motor supply chain

Every element of Lucid's operations as an automaker is guided by the notion of sustainability. Lucid Air's objective is to create the most efficient electric vehicle ever created. The company looks for materials from the most ethical suppliers, with a focus on long-term sustainability and recyclability. (Lucid Motors, n.d.)

They not only design zero-emission cars that can be fueled by renewable energy sources, but they are also committed to making the most of those resources.

Vehicles and powertrains must be as efficient as feasible in every area as the company develops them. That's why Lucid Motors' range efficiency per mile is the highest of any EV on the market. This isn't the standard in the industry. The range efficiency of Lucid Air outperforms the competition by a large amount. Lucid is actively working to lessen the human footprint on our world by reducing overall emissions during a vehicle's lifetime with every extra mile we can extract from a kWh of energy.

Lucid collaborates closely with suppliers to ensure that interior materials are both luxurious and environmentally friendly. Eucalyptus, walnut, and red oak are examples of sustainably sourced wood. An alpaca wool blend that requires less dye and recycled yarn produced with an innovative air-texturing method are two textile options. A bright example of that is Bridge of Weir which is known for its high-quality leather, but Lucid chose it because it has the lowest carbon footprint of any leather manufacturer in the world. It has earned this distinction — as well as environmental accolades — by investing heavily in circular leather manufacturing,

including a thermal energy plant that converts process waste into energy and an ultrafiltration plant that recycles 40% of the water used in Bridge of Weir's leather production.

Lucid's factory is built on a 500-acre property in Casa Grande, Arizona, after the business evaluated over 60 sites in 13 states. The Casa Grande offered close proximity to vital utilities, an established transportation system, and strong support from state and local governments. It was located between Phoenix and Tucson and was within easy reach of the company's Silicon Valley headquarters.

This is North America's first greenfield electric vehicle manufacturing. It is being built to Lucid's exact measurements and with such efficiency and speed that the first phase will be completed just 12 months after breaking ground. The factory, which will be equipped with the world's most advanced manufacturing line equipment, will have an initial capacity of 10,000 automobiles per year, with plans to expand to over 300,000 yearly. (Lucid Motors, n.d.)

4.2.3 Similarities and differences of the supply chains

At present, whole automotive industry is shifting towards zero-emission, environmentally friendly, socially responsible manufacturing, and electromobility. (Cubic Team, 2021) For that, both market leaders such as Volkswagen and Tesla, and newer companies, such as Lucid, create sustainable supply chains, ensuring that on every stage of their supply chain sustainability requirements are met. Besides, there is a major trend towards using environmentally friendly materials and collaborating with ethical partners. So far, we can conclude that all three companies mentioned in this paper are faring well in regard to that.

However, there are several differences in their supply chains that must be mentioned and those can also explain why in the periods of the global downfall Tesla was able to stay afloat and did not experience significant financial losses, unlike other companies.

First of all, as Tesla has only several factories, it is easy for them to react quickly to any supply chain-related issues and reorient manufacturing in any moment needed. A bright example of that is creating in-house competence of their software code writing while their competitors depend on their suppliers for that. For Volkswagen, which has a huge production network worldwide, when facing problems related to failures or delays in the supply of materials, having that quick reaction is not possible.

Secondly, having long-term and close relationships with their suppliers. Even though Tesla disclosed the list of their suppliers just recently, the company had long-term relationship with most of their suppliers. This ensures the company that they will have all the necessities years ahead. This is not the case, for example, for Lucid motors, as, just recently, they faced the situation of supply shortage and due to "exceptional" logistics and supply chain issues, the company's production target for 2022 has

been reduced to a range of 12,000 to 14,000 automobiles, down from a previous aim of 20,000 for the year.

Thirdly, Tesla was the first in the market to offer electro automobile as well as was the first to declare the shift towards sustainability in the automobile industry. Therefore, they still enjoy the time-based advantage compared to their competitors.

4.3 Example of the chip shortage

In the following section, the differences in the supply chains and approaches of Tesla and traditional automakers are compared and analyzed based on the global chip shortage.

In times of the Corona pandemic, many factories were either completely closed or new laws were imposed by various governments that prevented them from continuing to produce at a fast pace. Social distancing and hygiene regulations have thus also affected many microchip and semiconductor manufacturers, who have had to shut down their production or even close the factories completely for some time.

In addition, due to the pandemic, the working world moved more and more towards home offices, but also private tech devices were more in demand, as people were forced to stay at home. As a result, the demand for microchips or devices using microchips increased sharply.

The vehicle industry was one of the hardest hit by the chip shortage. Almost all vehicle manufacturers cut back production at the beginning of the pandemic and ordered fewer microchips accordingly. When they wanted to have more chips again because they had ramped up production, they were already out of stock due to the chip shortage. And since the automotive industry is an area in which relatively few chips are needed, it is now being put on the back burner because smartphone or computer manufacturers have to be supplied first. (Kolodny, L., 2022) (Ashcroft, S., 2022) (Allan, M., 2022)

Despite this global chip shortage, however, Tesla managed to continue to produce record numbers in the fourth quarter in 2021, when the chip shortage peaked. The automaker sold more vehicles than in previous years.

Other traditional automakers did not manage to do so. VW initially had to cut its production by 40% during the chip shortage and at times even shut it down completely.

Tesla managed to overcome the problem of the chip shortage. This was possible because Tesla has a completely different way of approaching the production of a vehicle. Tesla designs its vehicles from the ground-up and is integrated into every production process. For Tesla, it is very easy to adapt new parts or even quickly switch to new parts if the ones used so far are not available.

For example, Tesla removed the front passenger-seat lumbar features because they would have required a microchip, which is not available at the time. Tesla responds very quickly to such changes in the supply chain and adjusts production. Since Tesla designs the vehicles from scratch, the company does not have to wait for annual update cycles, but can make changes exactly when they are needed. The supply chain, as well as manufacturing, is completely vertically integrated at Tesla.

Another modern approach that has not been seen in the auto industry is that Tesla delivered vehicles where parts were missing. These were then retrofitted as soon as they became available again. (Kolodny, L., 2022) (Ashcroft, S., 2022)

Another thing Tesla has done in the wake of the chip shortage is to use other microchips. Since Tesla has a software team with strong knowledge and they are the market leader in software, Tesla managed to rewrite the software quickly. When the company couldn't get their hands on a microchip because it wasn't available, they simply switched to a different type of chip and rewrote the software so that it would work on the new chip without any problems. VW CEO Herbert Dies himself admitted that Tesla managed to rewrite the software to work on a different chip within a week. This gives Tesla a time-based advantage and makes it a time-based competitor with the best prerequisites and the greatest advantages over traditional car manufacturers. (Allan, M., 2022)

Traditional automakers have been hit much harder by the chip shortage. VW is not the only company where production came to a halt. Many companies had to scale down or even stop production altogether. Traditional automakers rely on annual update cycles because they get most of their parts from various suppliers and don't build their vehicles from scratch. So if one microchip is missing, they can't just switch to another. The traditional automakers are powerless here and cannot make quick changes. (Allan, M., 2022)

4.4 VRIO Analysis of Tesla

In the following section, a VRIO analysis of the Tesla company is performed. For this purpose, the VRIO framework is first explained. The VRIO analysis is then carried out in tabular form and the individual points analyzed are explained.

4.4.1 VRIO Framework

Using the VRIO framework, an internal analysis of Tesla is conducted to find the advantages and resources that give the company an edge over the competition. With the VRIO analysis, the benchmarks for the success of a company are recorded.

VRIO stands for the four categories that are analyzed: Value, Rarity, Imitability and Organization. The VRIO analysis is about identifying all these factors and looking at how they compare to the competition in the analyzed company.

It is important that the company must be superior in all or sometimes most of these points in order to have either a competitive advantage or even a sustainable competitive advantage.

The value refers to the specific needs that are important for the product. It looks at what specific capabilities or resources are provided to the customer from which they can gain an advantage. It also answers the question of why the customer chooses exactly the product of the company being analyzed and not the product of the competition. The question of value and the associated uniqueness of the product should be answered here.

Rarity looks at how accessible the resources or products are for the customer. It is analyzed which resources that are difficult to access are only available to the company being analyzed and which unique capabilities or products result from this. It is also looked at whether there is a high demand with a low supply, which makes the desirability of the product increase. Rarity is very important as it usually creates a good and desirable product when combined with value.

Imitability is considered next. It answers the question of how well it is possible for competitors to imitate the product. So again, it is about how unique the product is. It analyzes how easy it is to duplicate the product and how high the costs are that the competition has to incur. It is also looked at whether there is something comparable that already exists. This aspect is also very important. If the product is rare and of high value, but everyone can copy it, it will not remain rare and of high value for long. Then only a competitive advantage is created, which only lasts temporarily.

The last thing to analyze is the Organization. This analyzes the structure of the company. It is examined whether there are liquid operational sequences in the enterprise, which function well. The product can only be successful on the market if there are management structures that guarantee continued success. It is these structures that ensure that a sustainable competitive advantage can be created. (QuestionPro, n. d.)

4.4.2 VRIO Analysis

In the following table, a VRIO analysis of the Tesla company is performed. Here, 8 resources are considered, and they are analyzed according to the four analysis factors Value, Rarity, Imitability and Organization. This results in the competitive advantage of the company. Subsequently, each individual point is explained again in concrete terms.

No.	Resources	Value	Rarity	Imitability	Organization	Competitive advantage
1	Brand image	Yes	Yes	Yes	Yes	Sustainable competitive advantage
2	Market position	Yes	Yes	Yes	Yes	Sustainable competitive advantage
3	Technology	Yes	Yes	Not yet / unlikely	Yes	Sustainable competitive advantage
4	Production facilities	Yes	Yes	Unlikely	Yes	(Potential) competitive advantage
5	Supply chain network flexibility	Yes	Yes	Partly yes	Yes	Sustainable competitive advantage
6	Innovation	Yes	Yes	Yes	Yes	Competitive advantage
7	Charging Network	Yes	Yes	Only in the long run	Yes	Temporary competitive advantage
8	Customer experience	Yes	Yes	Yes	Yes	Competitive advantage

Table 1: VRIO Analysis table

4.4.2.1. Brand image

Tesla's brand image is a core competitive advantage of the company. Tesla's brand image is a unique selling point in the automotive industry. The company has the image of the transition leader in the entire automotive industry. The hype surrounding Tesla is unmatched in the automotive industry and more comparable to the hype in the tech industry, with companies like Apple. This brand image ensures increasing popularity, a loyal customer base and thus also increasing sales figures, as well as high demand.

The special thing about the strong brand image is that Tesla does not have a marketing department and does not do any conventional marketing. The company scores in this area through constant innovation and constantly new drastic ideas or product and services. (Light, L. 2020)

A good example of this is the introduction of the Tesla Cybertruck. This has a so drastically different design, than models of the competition, that thereby a regular hype developed on the internet. Since the introduction of the Cybertruck, there are many new YouTube channels that have

started to produce Tesla news with a special focus on news about the Cybertruck.

This word-of-mouth publicity, among other things, provides Tesla's strong brand image and thereby gives the company a sustainable competitive advantage. (Brandtastic, 2021)

4.4.2.2. Market position

Another important advantage Tesla has over its competitors is its positioning in the market. Here, Tesla also has a big lead over the competition. In 2022, Tesla had a market share of 75% in the USA. (Emir, C., 2022) Accordingly, the competition here has much smaller market shares and lower sales figures than Tesla.

Tesla has the advantage of being the first large, mass-market company to produce electric cars for a wide customer base. This also created Tesla's enormous technical advantage. The company is way ahead of its competition in things like battery production, powertrain production, driver safety, and mass production of electric cars.

Tesla will continue to have a big advantage over its competitors in this area in the future as well. This is because, on the one hand, the demand for electric vehicles continues to rise and, on the other hand, Tesla's popularity and name recognition is also increasing. As a result, Tesla's market position will remain strong in the future. This aspect provides the company with a further sustainable competitive advantage.

4.4.2.3. Technology

The technological aspect is also of enormous importance. Here again, Tesla has a big advantage over the competition. Especially in the production of batteries and powertrains, which are the most complex and expensive parts in an electric car, Tesla has a clear advantage. Tesla began early on to develop innovative batteries itself and to look for ways to make them more efficient and less expensive. The company has succeeded in this, as Tesla's batteries are cheaper and more efficient compared to the competition. Another advantage the company has is that it manufactures batteries and powertrains itself. This allows the company to gain even more technical know-how and to offer the vehicles at a lower price, since production costs can be minimized. (Crider, J., 2021) (Johnson, J, 2021)

Tesla has another advantage in the area of software. This is also more advanced compared to the competition. Tesla's software in its vehicles, as well as software such as Full Self Driving, are far ahead of the competition. This gives Tesla another sustainable competitive advantage. The technology of Tesla can be imitated by the competition, but it takes them many years to do so. The problem here is that if the competition were to start imitating Tesla's progress today, they will always lack many years of experience that they will never get back.

4.4.2.4. Production facilities

Tesla owns its own production sites around the world with the Gigafactories. In the Gigafactories, the vehicles and batteries are produced in one place. This enables Tesla to quickly make changes in production if this is possible due to external influences. Tesla also has a high level of know-how about its own products, as the company has not only designed and developed them itself, but also produces them independently in the Gigafactories.

Another advantage of the Gigafactories is that Tesla can always produce everything locally. Locations all over the world make it possible to avoid long delivery times and high transport costs. In addition, the company can also better adapt to the local market. For example, SUVs are more in demand in Germany and Europe. For this reason, Tesla only produces the Model Y in Germany. Pick-up trucks are not widely available in Europe and are not suitable for European roads. However, they enjoy a high popularity in America. That's why the Cybertruck will be produced exclusively in the USA.

Another advantage that Tesla has due to the Gigafactories is that the company can produce very large quantities. This is not possible for the competition due to many supply-chain limitations. Tesla, for example, builds the batteries itself and has found a way to keep costs low and continue to reduce them. The competition has to buy the batteries from third party manufacturers. Since every competitor of Tesla must do this and the demand for electric vehicles is rising, the demand for batteries will also rise sharply. This in turn will lead to an increase in the price of batteries.

This gives Tesla another sustainable competitive advantage, which will not be caught up by the competition in the foreseeable future. (Pressman, M., 2017)

4.4.2.5. Supply chain network flexibility

Tesla attaches great importance to making its supply chain flexible. The company achieves this by always having several suppliers for its parts. This guarantees that the company can react flexibly if there are problems with one of the suppliers. The company does not make itself dependent. This gives Tesla the control and agility to change things quickly and not be dependent on a strict supply chain.

Another aspect that Tesla is increasingly putting into practice is that the company takes over many production steps itself to not be dependent on suppliers. For example, the company built a factory for seats in just a few months because of problems with suppliers. By moving more and more production in-house, Tesla is less dependent on suppliers.

Likewise, it is an advantage that Tesla can easily change the software so that it works on other chips. This change in in-house production also gives the company greater flexibility in its supply chain.

This gives Tesla another sustainable competitive advantage over its competitors, as they usually rely on a strict supply chain and cannot change it as quickly as Tesla. (Field, K, 2020)

4.4.2.6. Innovation

Tesla is second to none in the field of innovation. The company has already brought many new innovations to the vehicle industry in the field of software, battery technology, charging network infrastructure and autonomous driving. Still, no manufacturer manages to surpass these innovations. Tesla has been a pioneer in this area.

Likewise, the company has delivered other innovative approaches in the area of production and supply chains that have significantly shaped the auto industry.

However, the company continues to work on new innovations. Tesla unveiled the Cybertruck in 2021. This futuristic-looking pick-up truck is optimized for production. Everything about this vehicle is designed to be as easy as possible to manufacture in production. For example, the chassis consists of an exoskeleton and thus only one part. With such design approaches, Tesla is even further ahead of the competition. The latter can simplify its supply chain on the chassis side, but it still needs one, while Tesla only needs to press exoskeletons.

Tesla is also planning further innovations in the area of Full Self Driving. For example, the company announced Robo taxis that will soon be fully autonomous and driverless. The competition is far away from producing systems like this.

(Livescalt, J., n. d.) (Naik, A. R., 2021)

4.4.2.7. Charging network

Tesla is the only vehicle manufacturer that owns a worldwide network of fast charging stations, the Tesla Superchargers. Tesla was the first company to address the problem of charging infrastructure and started to build the Supercharger network. This score points for many aspects. It is the most widespread fast charging network and therefore the most accessible. In addition, customers appreciate the ease of use of the Supercharger. Unlike other charging networks, customers do not have to pay each time they use the Supercharger; instead, the vehicle communicates with the charging station and the money is automatically debited. Superchargers are also a very reliable charging network and very stable in terms of price.

Since the spread of the charging network is already so advanced, it is difficult to copy from the competition. There are other charging networks, but they have to make compromises in terms of usability, price or expansion. The Supercharger network gives Tesla another advantage over the competition. (Merano, M., 2021) (Munster, G., Stokman, D., 2021)

4.4.2.8. Customer experience

Tesla has another decisive advantage over the competition in the customer experience. The company consistently scores positive customer reviews and many awards for its vehicles. The primary reason for this is that Tesla has shifted its focus to other things. Tesla prioritizes software in its vehicles and manages to attract many new customers as a result. Many Tesla customers are new customers who were not necessarily interested in a new car before. However, they are now doing so because Tesla is delivering something that has never existed before. Teslas resemble a tech product more than a vehicle.

Another difference is the minimalist design of the vehicles. This is drastically different from the classic design of the competition, which is characterized by a multitude of buttons for every possible function. In a Tesla, these are all eliminated, and everything is controlled via the central display.

There is another advantage for the customer when it comes to maintenance. Teslas are also very popular because they do not require much maintenance. As a result, there are hardly any maintenance costs. If maintenance is necessary, it can be solved through innovative new methods, such as over-the-air updates or Tesla's maintenance service, which comes to the customer's home.

This gives Tesla another competitive advantage that other manufacturers have not yet been able to match.

4.4.3 Result of the VRIO Analysis

Based on the VRIO analysis, it is clear that Tesla has a big advantage over the competition in the automotive industry. Tesla has brought so many new aspects to the automotive industry that it has not been able to keep up with the rapid pace of innovation. Tesla has managed to revolutionize not just one aspect, but several.

Starting with the new way of manufacturing vehicles. Tesla has revolutionized the entire concept of how a vehicle is made. The manufacturer builds the vehicles itself from the ground up, making sure that they are as simple as possible to produce. In addition, the manufacturer builds the vehicles almost entirely himself, thus making himself independent of the complex supply chains in the automotive industry. The supply chains that the manufacturer still has are handled differently than those of conventional vehicle manufacturers. Like a technology company, Tesla always makes sure it has a multi-layered supply chain to avoid bottlenecks.

But Tesla also offers completely new approaches in the areas of customer experience and brand image. The vehicles are designed differently from the ground up. The high focus on software plays the biggest role here. As

a result, Tesla is seen more as a technology company. This is also reflected in the brand image, which is unique in the entire automotive industry. There is a real hype around Tesla, which is similar to that of Apple.

Tesla has then still managed to penetrate into new areas. The company constantly delivers new innovations. Starting with the Supercharger network, which allows customers to charge easily and is a huge buying aspect of Tesla, and stopping with vehicles like the Cybertruck, which have a completely drastic design that is optimized for production.

Because of these aspects, Tesla manages to stay ahead of the competition and has a steady lead that continues to expand.

5 RECOMMENDATIONS

In the following section, recommendations will be made as to what other automakers, such as the aforementioned Volkswagen and Lucid Motors, but also others, can do to catch up with Tesla or even stay one step ahead of the company in the future.

Probably the most important point here is that traditional automakers in particular must be willing to change their entire business model. The approach to the question of what a car is has to be different. In the modern world, a car is no longer a high-horsepower, highly customizable vehicle with lots of buttons and just a simple navigation system. A car today is a computer on wheels. This is a fact that traditional automakers in particular need to recognize. The software must play a much stronger role. There should also be a focus on ease of use, and the car should be less boring. Playful gimmicks may be included to make the experience of the car more fun.

Another important aspect is the focus on sustainability. It must be clear that the trend is toward electric cars. Even though many still resist it these days, the future will be electric. There is no way around electric cars. Resources are not endless and a transition will have to take place sooner or later.

Automakers should not sleep through this trend. They need to focus more on sustainability and start producing more electric cars. In the long term, carmakers should also think about having only electric cars in their portfolio. This is the only way to ensure a secure future and survival in the modern vehicle market.

Furthermore, carmakers must become more innovative. Apart from Tesla, there have been very few innovations on the vehicle market in recent years, even though concepts show that these are very much possible. Nevertheless, hardly any carmakers dare to try something

drastic and new. More courage must be shown here. Only in this way is it possible to win new customers and take on a pioneering role. The willingness to take risks must increase.

But many manufacturers can also take an example from Tesla on the production side. Tesla shows how vehicles can be produced in large numbers. Here, production takes place in one place. This is an example that some automakers could follow. Vertical integration must be increased here.

This also applies to the supply chain. Here, too, automakers should try to design their vehicles from the ground up in such a way that they are easier to produce and parts from different suppliers can be installed. This is enormously important in order to become less dependent on individual suppliers.

Tesla took a very high risk at the beginning, which has paid off. The company invested a lot of money in its factories and in the Supercharger network without making a direct profit. Tesla did this without having much capital of its own. These investments only paid off after years.

Many of the big carmakers have this capital and it would be financially easier for them to make these investments. However, two basic things are lacking here: First, there is a lack of courage, as investing in their own battery production or charging network infrastructure sounds too daring, and second, many carmakers also lack the necessary know-how to tackle these investments properly.

Here, too, many automakers can take Tesla as an example. They should acquire qualified personnel and then be prepared to make more daring investments.

All these examples show that it is a long way to catch up with Tesla or even to overtake it. Nevertheless, it is possible. The carmakers just have to be ready to make far-reaching changes in their business model. The advantage they have is that carmakers can all learn from Tesla's mistakes and look at the successes to implement them.

6 CONCLUSION

The goal of this bachelor thesis was to show how the Tesla company could significantly change the automotive industry. It also showed how the supply chains of Tesla and competing companies work and where the differences lie here and why Tesla has a big advantage over the competition. The research question was: How has the car manufacturer Tesla managed to permanently change the vehicle industry and how does the company manage to always be one step ahead?

The work showed that Tesla has many advantages over its competitors. The company operates in a completely different way and has a very different history than traditional vehicle manufacturers. Tesla operates more like a technology company than an automaker. This modern approach gives the company a lot of popularity and many new opportunities to solve problems faster and better. The company also manufactures its own vehicles from the ground up, allowing it to respond more quickly to market fluctuations or problems that arise. The comparison with the VW Group showed the advantages Tesla has and how it can solve problems more innovatively, while traditional manufacturers like VW have to deal with bigger problems here. The concrete example of the worldwide chip shortage was then used to show how Tesla was able to solve the problem more successfully than its competitors.

Furthermore, the VRIO analysis was used to concretely show where exactly Tesla's advantages lie. The analysis showed exactly what the advantages are and why Tesla has them.

Finally, the recommendations section explained what other manufacturers, such as Volkswagen and Lucid Motors, can do better and what areas these car manufacturers should focus on to catch up with Tesla.

This answered the research question and confirmed through several examples that Tesla has a time advantage over other manufacturers. It was also shown how Tesla has managed to significantly change the auto industry through its modern and new approaches.

The car industry is still in the process of change. Some companies are already further along in this process than others. In the future, this process will continue and it will become clear which companies will successfully manage the transition and which will not. The transition to electric cars will be the most important aspect of this. It will become clear which car manufacturers will manage to successfully develop their production, their market strategy and their vehicles in order to survive on the market in the future.

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