



Industry Case Analysis: Tesla's Strategy towards Mass Production of Electric Vehicles

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Abstract

This thesis examines whether Tesla possesses sustainable competitive advantages in the mass production of electric vehicles over its German competitors. Thus, it seeks to decrease the two identified research gaps of Tesla's production strategy and of Tesla's competitive comparison to the German automotive industry which is substantially ramping up production of electric vehicles itself. To examine this coherence, the most appropriate method of analysis is found to be the examination according to Barney's VRIO framework which defines the four criteria of value, rarity, inimitability and organization for a competitive advantage to be classified as sustainable. The data to perform this analysis was collected using a survey with 71 respondents and 10 semi-structured interviews with both groups being composed of Tesla employees and employees of the most relevant German competitors BMW, Mercedes-Benz and Volkswagen. The survey found a total of seven relevant competitive advantages, Tesla possesses towards the mass production of electric vehicles over its German competitors. These competitive advantages are then quantitatively assessed by the survey results on the VRIO framework and qualitatively assessed through the information provided by the expert interviews. This combination of analytical methods not only leads to the classification of five competitive advantages as temporary but also to the classification of two as sustainable competitive advantages: Firstly, Tesla's speed & agility which refers to the company's high operating & decision-making speed as well as fast construction & commission of new factories. Secondly, Tesla's vertical backward integration of component manufacturing and future in-house battery cell production.

Resumo

Esta tese examina se Tesla possui vantagens competitivas sustentáveis na produção em massa de veículos eléctricos em relação aos seus concorrentes alemães. Assim, procura diminuir as duas lacunas de investigação identificadas da estratégia de produção da Tesla e da comparação competitiva da Tesla com a indústria automóvel alemã, que está a aumentar substancialmente a produção de veículos eléctricos em si. Para examinar esta coerência, o método de análise mais apropriado é o exame segundo o quadro Barneys VRIO, que define os quatro critérios de valor, raridade, inimitabilidade e organização para que uma vantagem competitiva seja classificada como sustentável. Os dados para realizar esta análise foram recolhidos utilizando um inquérito com 71 inquiridos e 10 entrevistas semi-estruturadas com ambos os grupos sendo compostos por empregados da Tesla e empregados dos mais relevantes concorrentes alemães BMW, Mercedes-Benz e Volkswagen. O inquérito encontrou um total de sete vantagens competitivas relevantes. Estas vantagens competitivas são depois quantitativamente avaliadas pelos resultados do inquérito no âmbito do VRIO e qualitativamente avaliadas através das entrevistas de peritos. Esta combinação conduz não só à classificação de cinco vantagens competitivas como temporárias mas também à classificação de duas como vantagens competitivas sustentáveis: Em primeiro lugar, a rapidez e agilidade de Tesla, que se refere à elevada velocidade de funcionamento & tomada de decisões da empresa, bem como à rapidez de construção & encomenda de novas fábricas. Em segundo lugar, a integração vertical retroactiva da Tesla no fabrico de componentes e na futura produção interna de células de bateria.

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As the final step of my Master studies at Católica, this Thesis has been of utmost personal importance to me. It offered me a unique opportunity to academically examine a research field and company of my free choice. The choice of Tesla has definitely provided me with a high motivation through my personal interest in this innovative and influential company. Nonetheless, this choice has substantially complicated the research process due to strict non-disclosure agreements which represented a major challenge for this thesis. But from overcoming this challenge and from the overall writing process, I was able to gain relevant experience and improve my analytical capabilities which I deem very useful for my future career.

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List of Abbreviations

EV Electric vehicle

Giga Gigafactory

LIB Lithium ion battery

R&D Research and development

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1 Introduction

The automotive industry has relied on the same form of propulsion since Carl Benz first steered the “Motorwagen” around Mannheim, Germany in 1886. A mere 134 years later, in 2020 Norway was the first country to have lower sales of combustion engine cars than electric vehicles (EVs). And the most popular car brand in Norway in 2021 was neither Mercedes-Benz, nor any other German manufacturer. It was Tesla with only two car models. More than 5% of all cars sold and more than 10% of all EVs sold that year were Tesla Model 3 (Trinkwon, 2021). The first mass-produced car of a car company that only produced their first series-production car less than 10 years earlier in 2012. Tesla is at the forefront of the worldwide paradigm change to electric mobility that has most western countries banning sales of new combustion engine cars from 2030 onwards or like the EU by 2035 (Carey & Steitz, 2021). While the Model 3 has been the words best-selling EV since 2018, Tesla’s main challenge appears to be producing enough of them (Caballero, 2022) Mass production of electric vehicles is the one factor that limits the sales volume every year and prevents an even faster change to electric mobility. Consequently, Tesla’s ability to mass produce electric vehicles like Model 3 and Y as well as its strategy to achieve that, bears significant research relevance.

1.1 Tesla’s History

To provide the fundamental knowledge about Tesla, its history will be briefly presented. The company was founded in 2003 by Martin Eberhard and Marc Tarpenning. A year later Elon Musk joined the company with a \$6.5 Million investment. Since 2008, Elon Musk is the CEO of the company, took it public in 2010 and sold the first series-production car that was fully built by Tesla in 2012. The first car that Tesla deliberately designed for affordability and mass production was the previously mentioned Model 3 sedan which started production in 2017 and commenced the second main stage in the company’s history. It was followed by the compact crossover SUV Model Y in January 2020. These two models are the most relevant models for mass production as new production facilities around the world are designed to only produce these models while the older two models will only be produced in comparatively low numbers in the United States. In June 2020, Tesla became the most valuable car manufacturer with a market capitalization of more than \$208 billion which has since risen to \$1.137 Trillion on the 3rd of April 2022, making it the sixth most valuable listed company worldwide. (Tesla, 2022)

1.2 Tesla Factories & Relevance of Gigafactory 4 Berlin

The term Gigafactory is used by Tesla for its new generation of major factories of which four have been completed to date and the fifth is currently under construction in the state of Nevada, United States. While Tesla's original factory in Fremont California has not been given the term, Gigafactory 1 in Nevada and Gigafactory 2 close to New York are producing components and accessories instead of cars. With the opening of Gigafactory 3 Shanghai, which solely produce Model 3 and Y, Tesla commenced the third main stage of its history by expanding its production to outside of the US. While Gigafactory 3 served as Tesla's main export hub for Europe, the opening of Gigafactory 4 in Grünheide near Berlin in March 2022 had a significant impact on Europe. Not only did cars no longer have to be imported from China, the fourth Gigafactory also includes one of only two production facilities of Tesla's innovative new battery cells which will substantially change Tesla's supply chain. With a planned production volume of 500.000 cars per year, Gigafactory 4 has a major significance for Tesla which only produced a combined 930,422 cars in 2021. (Tesla, 2022) (Tesla Quarterly Report Q4 2021, 2022)

1.3 Problem Statement & Research Gap

The recent opening of Gigafactory 4 Berlin in March 2022 results in the problem of research on Tesla not including a part of Tesla's strategy & production capability, that was previously established to be highly significant. Furthermore, the review of the academic literature on Tesla has revealed two significant research gaps. Firstly, no significant research has been focused on Tesla's production. Neither has research examined the ability or strategy of Tesla to mass produce EVs in substantial numbers, which represents the most significant challenge for the company. Nor have Gigafactory 3 and 4 been examined for their impact on Tesla's production capability and their relevance for the company. Secondly, while limited research has been performed to examine Tesla's Chinese competitors, none has compared Tesla to the highly relevant competing German car manufacturers. While Porsche and Opel are not considered due to low production volumes, BMW, Mercedes-Benz and Volkswagen are all building up significant production capabilities to mass produce EV's. And with Volkswagen's ID.3 being the second most sold EV in Europe in 2020, Tesla's needs to be compared to the highly relevant German competition and their respective mass production capabilities (Sharpe, 2021).

1.4 Research Aim & Objectives

The research aim of this thesis is to examine whether Tesla possesses sustainable competitive advantages in the mass production of electric vehicles over its German competitors. This includes any strategy or business action that currently has or will have an effect on Tesla's ability to either decrease its production cost or, as established in the introduction as the determining factor in the EV market, substantially increase its production volume.

- 1) Which competitive advantages does Tesla possess in the mass production of electric vehicles over its German competitors?
- 2) Are the identified competitive advantages temporary or sustainable?

The research performed in this thesis has the purpose of comprehensively examining the established economical coherence in order to answer the two presented research questions in an academically and scientifically appropriate manner. Thus, they represent the guiding element throughout this study, and the answer the study seeks to establish will be presented in the analysis & discussion section. In order to provide a more precise structure and approach that this thesis will pursue on its way to establishing these answers, three research objectives will be defined.

Firstly, a comprehensive literature review will serve the research objective of providing the existing knowledge and its assessment of the entity of Tesla's competitive advantages as well as an understanding of the underlying management theory of competitive advantages. The found competitive advantages and related knowledge will then serve as an additional method of evaluation of the research questions in the analysis & discussion part. Furthermore, the found literature will precisely define the research gap this research is seeking to decrease

Secondly, the research objective of developing a list of potential competitive advantages will be pursued which relates to the first research question. These competitive advantages will be developed without assessing them for their suitability for being sustainable. Thus, any business actions will at first be considered for analysis without being measured against the definition of a sustainable competitive advantage that will be established by the literature review and

methodology. This deliberately maximizes the width of business actions that can be examined and therefore the width of the metaphorical funnel of analysis. This research objective will be achieved by allowing both the expert interviewees and the survey respondents to freely and unbiasedly choose multiple competitive advantages. The then-emerging list of competitive advantages will be presented and ordered by occurrence to provide a structure and a basis for further analysis.

Thirdly, the last objective of this research relates to answering the second research question using an academically backed framework. Thus, the objective is to perform a classification of the found competitive advantages into either a sustainable competitive advantage or one of the less pronounced forms of competitive advantages that will be outlined in the methodology. The first method to achieve that objective is providing and analyzing a comprehensive visualization of how the respondents of both Tesla and the opposing German manufacturers assessed each individual identified competitive advantage. The second method complements this quantitative approach with the qualitative results obtained by the performed expert interviews of both Tesla employees and employees of the mentioned German competitors. These two methods in combination with the knowledge established in the literature review will allow for a well-documented and well-grounded identification of Tesla's sustainable competitive advantages.

2 Literature Review

As the presented introduction research aim elaborated, a comprehensive analysis of Tesla's strategy and potential competitive advantages requires an examination of a diverse variety of research fields. With competitive advantages representing the focus of this thesis, the respective management theory and the research field of business strategy are required to be comprehensively depicted. Consequently, this literature review will commence from the general knowledge of the underlying management theory. This perspective of the general field will then serve as the knowledge basis for the rest of the literature review as well as the final analysis. From this economical and theoretical perspective onwards, the field of the literature review will become more micro and specific to the actual content of this research. The clinical

literature will be examined for their individual key ideas, the relation of the findings to one another and potential conflicting results. These examinations will result in the current state of clinical literature on Tesla's strategy and competitive advantages. In addition, a potential lack of research towards subparts of these fields will be examined to identify research gaps which will serve to justify the research direction of this thesis in the content following the literature review. For the sake of comparability, the final aim of this review is to identify and review clinical literature that offers verified knowledge on parts of Tesla's strategy and potential competitive advantages that are relevant for this thesis. These competitive advantages will be put in context by providing the relevant circumstances of change in the industry and competitive landscape at the time. Due to the focus of this thesis on the production side, a special emphasis will be put on competitive advantages regarding production, supply chain and vertical integration.

Given the fast development of Tesla and change of strategy, as described in the introduction and depicted in the timeline, this literature review cannot be purely structured by content. Tesla went through various significantly different stages with each exhibiting individual strategic goals, industry circumstances and most significant competition. Consequently, literature regarding one of Tesla's competitive advantages that were present in one company stage can impossibly be directly compared to those of a different company stage. This coherence is further underlined by the upcoming of new research evidently following stages of Tesla's development, which when analyzed on a timeline, automatically provide a separation into three distinctive periods. This coherence provides the structure of this literature review after the presentation of the underlying management theory. Firstly, literature on Tesla's establishment and initial strategy will be presented. This section will not examine the fairly unknown beginnings of the company which is of lower relevance for this thesis but rather the first strategically significant years after the release of the Model S in 2012 from 2015 up until and including 2016. Secondly, literature on Tesla after refocusing on mass production through the development and initial limited production of the Model 3, as outlined in the introduction, will be presented. This section will cover the years 2017 up until and including 2018. Thirdly, literature on Tesla after expanding production beyond the United States will be presented, based on the announcement of Gigafactory Berlin in November 2019 and the production start of Gigafactory Shanghai in January 2020. Consequently, this section will cover the period of 2019 up until the most recent literature from October 2021.

2.1 Theoretical Background: Literature on Competitive Advantages

Despite the fact that the concept of competitive advantages is over 35 years old it is still one of the most relevant concepts in both economy and management studies. For a thorough review of the concept, two books that are now considered as the two of the most impactful pieces of literature on business strategy, have to be examined. With the first book *Competitive Strategy: Techniques for Analyzing Industries and Competitors* published by Michael Porter in the Free Press, New York in 1980, he introduced concepts on which the concept of the competitive advantage is based upon. The book provides the first comprehensive framework to provide an analytical understanding of three aspects that are considered essential for any firm. The understanding of a firm's industry, its competitors and the basic formulation of a competitive strategy. Regarding a firm's industry, Porter defined five competitive forces of industries and their implications for a firm's strategy (Porter, 1980, p. 3). Today, this concept is arguably one of the most recognizable frameworks in business studies, namely Porter's five forces. Further understanding is provided on how these factors change over time and how a firm's is able to develop and exert an influence on these factors through a comprehensive business strategy. On the subject of competitors, Porter provides an understanding of how competitors are likely to react to changing industry factors and a firm's change in strategy. Most importantly, in chapter two he elaborates on three strategic approaches to a competitive strategy in order to use the previously mentioned concepts to a firm's advantage. These approaches are his first identification of strategies to achieve a competitive advantage and will therefore be examined in more detail.

Overall Cost Leadership describes the strategic approach of committing to severe cost control to achieve a favorable company position (Porter, 1980, p.35-37) This cost leader position allows for a remaining margin despite intense industry rivalry that will diminish the profit of any firm that has not strategically prioritized cost reduction. While costs can be cut at various points, the largest focus for any producing firm is put on the production itself. In his elaboration on said strategy, two statements about what actions are required for the strategy stand out as extremely relevant for this research. Firstly, Porter states that the strategy “may well require designing products for ease in manufacturing, maintaining a wide line of related products to spread costs, and serving all major customer groups in order to build volume.” (Porter, 1980, p. 36).

Secondly, he elaborates that the strategy initially may require “heavy up-front capital investment in state-of-the art equipment, aggressive pricing, and start-up losses to build market share.” (Porter, 1980, p. 36).

Differentiation as the second of Porter's strategic approaches, in contrast, provides that a firm chooses to differentiate the product in a way that makes it unique within the industry (Porter, 1980, p. 37,38). Various aspects of the product itself as well as respective sales process or after-sale service may serve as a differentiation factor. Overall, Porter notes that the strategy represents a tradeoff with costs due to potentially costly actions to achieve differentiation and therefore that costs cannot be one of the firm's primary strategic targets. The intended result of such a strategy is on the one hand an increase in customer brand loyalty and a reduction in price sensitivity. On the other hand, it therefore achieves an increase in margin and an entry barrier for competitors due to the need to overcome the uniqueness.

Lastly, the strategic approach of Focus includes the specialization of the firm on a narrow strategic niche that it is able to serve either more efficiently or more effectively (Porter, 1980, p. 38-40). Within this strategy, two sub-strategies are identified. While both target a narrow segment, the cost focus aims at cost advantages, the differentiation focus aims at differentiation in that segment. As a worst-case scenario, Porter defines a situation where the firm does not follow either strategy firmly, resulting in a so-called stuck-the-middle position within its industry.

The second book of interest in which Porter builds upon and expands the concepts introduced in the previously mentioned book is his *Competitive Advantage – Creating and Sustaining Superior Performance* which was published in the Free Press, New York in 1985. Five years after the previous book, Porter intended to expand and improve previous concepts and add more detail on how firms can achieve and especially sustain competitive advantages. While proceeding with the three basic strategic approaches to achieve such advantage he adds an examination of how firms can succeed in simultaneously pursuing multiple of these approaches which is particularly interesting for this study. Despite his earlier presentation of cost leadership and differentiation as a trade-off, he states that “reducing cost does not always involve a sacrifice in differentiation” (Porter, 1985, p. 18). He then continues to differentiate between the

final cost advantage achieved by cost leadership and a general reduction of cost in a less extreme form. While he still points out that if there are cost-prioritizing competitors in the industry “a firm will ultimately reach the point where further cost reduction requires a sacrifice in differentiation” (Porter, 1985, p.18). This expansion of his original concept opens up a range of strategies that include both strategic approaches. In his observation, firms are able to reduce cost while simultaneously increasing differentiation “by using practices that are both more efficient and effective or employing a different technology.” This coherence will likewise be revisited in the discussion part of this study.

2.2 Literature on Tesla’s Establishment and Initial Strategy

Logically, earlier academic interest was focused on how Tesla as a newly founded startup was initially able to successfully position itself as a car manufacturer in the automotive industry. Despite Tesla being founded in 2003, as established in the introduction, it only receives significant research interest after 2012 when it released the Model S. Stringham, Miller & Clark (2015) reviewed entry barriers in the automotive industry and how Tesla dealt with them in their eponymous research “Overcoming Barriers to Entry in an Established Industry: TESLA MOTORS”. At the time of this research, Tesla was producing Model S and Model X for roughly three years but only fantasized about a \$35,000 car, and historically production of Model 3 and Model Y would only start two years later. Consequently, it was a period where Tesla only produced cars in the premium sector and in volumes that dwarfed that of established car companies. The methodology of this research follows a qualitative approach including expert interviews in the industry but also interviews with Tesla employees and Musk himself which represents the only research presenting and using an internal view of the company. Regarding their initial analysis of the industry, the authors first identify the automotive industry to both possess very high entry barriers based on an analysis using the respective predominant concepts developed by Porters and others (Stringham, Miller, & Clark, 2015). They described it as one with high initial capital and R&D requirements as well as covered by various established companies with strong competitive positions confirming the previously presented scientific view. Despite the inherent industry need of these companies to continuously innovate, they note that only with new entrants, maximum innovation and innovation pressure can be achieved. When analyzing the success story of Tesla, they use a comparison of Tesla’s strategic

approaches not only to those of the established automotive industry but rather to the typical Start-up mentality in the Silicon Valley. In doing so, they were able to identify eleven approaches Tesla evidently used that stand in contrast to typical industry practice. While these approaches do not qualify as a full strategic approach or competitive advantage due to their miniature impact relative to Tesla's overall strategy, three factors that touch on aspects relevant to Tesla's production strategy will be mentioned. Firstly, they pointed out an use of an iterated design process that enables constant innovation and focuses on a direct feedback loop to enable mass-market readiness in only three major iterations which is substantially fewer than the industry standard. Secondly, Tesla's approach to improving the entire customer experience including charging stations is mentioned, which obviously stands in contrast to the extent the industry typically exerts an influence on customer experience. Thirdly, on the strategic option of cooperating with other companies, they coincided with Cheong, Song, & Hu in their finding that strategic partnerships like with Panasonic for battery cell development and production have played a major role in Tesla's success story. Furthermore, Cheong, Song and Hu also examined a temporary investment of both Mercedes-Benz and Toyota in 2014 that lead to joined development of EV components. Both alliances were later abandoned due to conflicts of direct competition when both manufacturers began to start own major EV production in 2016 (Reuters, 2017).

2.3 Literature on Tesla after refocusing on Mass EV Production

In the years following 2016, there was evidently very limited research interest in Tesla as no considerable research was published in the academic journals that directed new research towards Tesla. In September 2018, that substantial research effort focused on Tesla again. In volume 14 Issue three of the *Management and Organization Review*, four articles were published in the Dialogue in, Debate, and Discussion part that intensely discuss Tesla, representing a major part of the total research about Tesla to date. These four perspective pieces emphasized the same three aspects of Tesla, namely how it was able to establish itself and overcome entry barriers, its similarities, and differences to the rest of the industry, and what the two previous aspects mean for the future of the industry. Especially, the possibility of US and Chinese tech companies following Tesla's lead in the initial development of an EV and the Chinese EV competitors are examined but the articles arrive at very opposing conclusions to all of these aspects.

Analyzing the success history of Tesla, Perkins and Murmann concluded the controversial thesis, based on the Tesla Model S case, that a “well-funded company could develop a new electric vehicle (EV) from scratch and move it into production within 3 to 5 years, by spending \$1– 2 billion of capital for design, development, and manufacturing.” (Perkins & Murmann, 2018, p. 471). This statement will then lead them to argue for reduced entry barriers in the industry and raise the question of which companies were already attracted by this seemingly easy entry and which will be attracted in the future. In contrast, MacDuffie opposed the statement by stating that in his view, “Tesla should be seen as a niche luxury car producer up to the 2017 launch of the Model 3” (MacDuffie, 2018, p. 482). Arguments for this assessment were provided by his description of Tesla’s initial market as a small-volume, craft-like market niche. Consequently, he rejects Perkins & Murmanns five year time frame and defines it to be 14 years (2003-2017) until production of the Model 3. The third author of these related pieces of literature coincides with MacDuffie by presenting the assessment that “Until an EV-only entrant achieves mass-market acceptance and high-volume manufacturing, it will be hard to argue that lower barriers to entry for EV design and manufacture pose a threat to incumbents.” (Teece, 2018, p. 504).

Furthermore, all mentioned authors assign high importance to the IT aspect of car development for which it is stated that “It is conceivable that in the long term controlling the automotive IT platforms may become more valuable than making the car itself” (Perkins, Murmann, 2018, p. 478). A study by the fourth author offered a similar but yet differently focused future outlook. It examined the business opportunities that arise for China from the shift to EVs (Jiang & Lu, 2018). They argued that the competitive factors in the automotive industry shift from the objective quality of a vehicle towards the experience of transport. Consequently Chinese IT companies with knowledge in digital experiences and sufficient capital could enter the market with relative ease and success. Furthermore, an opportunity for upcoming Chinese EV manufacturers like Nio arises due to the EV revolution and the new competitive factor of experience leveling the playing field and making it easier to compete with established manufacturers. Perkins & Murmann (2018) expanded this to also include US-based tech companies like Alphabet or Apple which possess similar core competencies and more than sufficient capital. But while Perkins & Murmann express the solo effort of tech companies entering the industry as their expectation for the future, Lu coincided with the other two authors Teece (2018) and MacDuffie (2018) of the connected literature in their expectation that tech firms would only enter the EV market in alliance with an established car manufacturer.

Furthermore, MacDuffie added his perspective on Tesla's future competitors by also examining the established car manufacturers. He argued that cheaper EVs like the Chevrolet Bolt for \$35,000 and more expensive EVs from German manufacturers will lead Tesla to be "(...) be squeezed from above and below as the EV market matures." (MacDuffie, 2018, p. 489). This represents a discrepancy in the research field regarding which companies can be considered as the most relevant existing competitors and potential entrants, that in contrast to the established car manufacturers, purely focus on EVs and possess a competitive advantage of digital experience expertise. Regarding Tesla's strategic approaches and potential competitive advantages, Perkins and Murmann (2018) are the first to propose a comprehensive set of five core elements of Tesla's strategy based on their historic analysis. These will be directly quoted to prevent any potential ambiguity: "(i) proprietary integrated electric powertrain, (ii) vertical integration from development through to production and retail sales, (iii) significant incorporation of IT capabilities into the auto, (iv) uncompromising focus on battery electric vehicles, and (v) build-out of supercharger network and free charging for customers." (Perkins, Murmann, 2018, p. 476). Furthermore, they observed Tesla's higher-than-usual number of R&D employees, the intentional design of the battery pack being able to accommodate different battery cell chemistries and major innovations in over-the-air software updates. While the other authors do not further discuss most of these aspects, the relevance of vertical integration for Tesla in the past and for the future of the industry overall is repeatedly examined. Teece (2018) observed that a comprehensive vertical integration was always Elon Musk's plan and uses the previously mentioned acquisition of the German automation company, Grohmann Automation in 2016 as an example. He argued for vertical integration to be part of Tesla's past success story which coincides with Perkins & Murmann perspective. In contrast to Perkins and Murmann and Teece (2018) having concluded Tesla's plans for vertical integration to be extraordinary in the industry, MacDuffie (2018) viewed it as a common industry strategy and something Tesla had to learn just like every player in the market. Furthermore, he noted that vertical integration represents the best approach for Tesla to build future expertise, that in his opinion, will be required in the next company phases. While the four related pieces of literatures included the whole value chain in their analysis of Tesla's vertical integration, Ingram (2018) concludes only the vertical integration of the sales process and respective online sales focus to be extraordinary in the industry. This represents another discrepancy within the literature on the past and future relevance of vertical integration for Tesla and the industry.

2.4 Literature on Tesla after expanding Production beyond the United States

After this substantial leap in research on Tesla in 2018, following Tesla's limited production start of Model 3, research again stagnated for some years. Following Tesla's expansion of production beyond the United States through the announcement of Gigafactory Berlin in November 2019 and production start at Gigafactory Shanghai in January 2020, four highly relevant articles were published in 2020 and 2021. The first article by Cooke (2020) represents the most comprehensive examination of each of Tesla's individual Gigafactories and identification of competing EV & LIB (Lithium Ion Batteries) factories but in line with its publication in the journal *Sustainability*, focuses on respective factors. Furthermore, the author's research is the first to conglomerate extensive information about the Gigafactory 4 Berlin which was only descriptive and didn't include further conclusions which is why the more up-to-date information provided in the introduction will not be expanded at this point. The more relevant aspect of the research is its comparison of Tesla's overall production output both in terms of EVs but also in terms of LIB production to Chinese companies which he presents as the most relevant competition. He observed that by mid-2019, Tesla had signed contracts for Gigafactory 3 Shanghai to be supplied with battery cells from CATL (Contemporary Amperex Technology Co. Limited) for Model 3 and LG Chem for Model Y. On this development, the author stated that "model specifications continue to drive the Tesla philosophy of re-invigorating its vertical integration strategy" (Cooke). Hence, he argues for the model-specific supply by three major LIB producers to be extraordinary in the car industry. He also represents the first author to address rumors of Tesla's in-house battery cell production, which in his opinion would have a major impact on the supplier network in the future. Overall, he concluded that Chinese EV manufacturers like BYD represent the most relevant competitors for Tesla. Regarding LIB production, he concludes that except for Tesla's potential inhouse production, Chinese LIB producers are and will be the largest in the world and remain to have the largest market share. Published in the same journal and remaining a similar research focus, Noar, Coman and Wznizer (2021) compared Tesla to two other transportation mega-projects and the Tesla models to other EVs in the market. While said sustainability research focus reduces the relevance of these comparisons for this research, they derived a set of Tesla's success factors that are worth mentioning. Most notably, they identified a vertically integrated supply chain, a diversified product portfolio with many models, the Supercharger network and Tesla's brand as success factors. Furthermore, they coincide with Cooke to point to the sourcing of battery

cell materials as a major challenge for the EV market's future. While these studies focus on the practical side of Tesla's success, another research by Lang, Reber and Aldori (2021) examined Tesla's business model from a rather distanced economic perspective. They developed frameworks that attempt to explain how Tesla's business model creates and captures value and thus define it as a junction of modularity, platform technologies, and innovation ecosystems. While their research provides high detail on certain economic aspects of Tesla, the derived frameworks are not relevant for this research.

As the introduction of the literature review outlined, the structure follows the mentioned three company stages with the last research being the most recent (October 2021) and the research with the closest relation to the subject of this thesis. Even though the research was published in the *Journal of Next-generation Convergence Information Services Technology*, it has a sole business focus and directly examines Tesla's competitive advantages in the global automotive industry. Han (2018) identified and depicted six competitive advantages of Tesla and examined them using the VRIO framework to identify sustainable competitive advantage. He argued, that manufacturing, company-owned stores, and the supercharger network to all to classified as temporary competitive advantages. Battery pack & powertrain technology and Elon Musk as a brand factor are likewise assessed with the difference stated to be an unlikely imitation making them sustainable in the long run. The Gigafactory in contrast was assessed to only be potentially valuable, rare, unlikely to be imitable and not-yet organized and therefore classified as a potential sustainable competitive advantage. The significant difference to the research that will be performed in this thesis is therefore that the author only briefly analyzed very general competitive advantages of Tesla. He did not examine Tesla's mass-production production capabilities nor does he compare Tesla to any other actor in the industry which in combination with the entity of previously reviewed literature defines a significant research gap.

3 Methodology

With the literature review and therefore the first research objective of this thesis achieved, the methodology will proceed to provide a comprehensive presentation of the academic methods that will be used to achieve the second and third research objective. The overview of methods and an explanation of why they are academically appropriate to answer the defined research questions will be provided in the following sections.

3.1 Research Design

This research design section will focus on presenting how the used research methods are the most appropriate and relevant to answer the research questions defined for this thesis. The research questions define this research to be an industry analysis of Tesla as the main focus company and the mentioned German competitors to serve as comparison companies. The reason for the necessity of comparison to the industry was established in the literature review by presenting that the concept of competitive advantages is mainly a comparison of strategies and respective counter actions of competitors in a market. Therefore, this comparison is required to appropriately examine and lastly classify a strategy as a sustainable competitive advantage. The argumentation to only use German competitors is a combination of three main arguments. Firstly, as outlined in the introduction, Tesla's Gigafactory 4 represents the most recent, most innovative and most impactful of Tesla's factories that focus on mass production of EVs. Furthermore, its in-house battery production is only one of two of such Tesla production facilities and will therefore occupy a major role in its battery supply chain. Secondly, the automotive industry is a very large and comprises dozens of companies that were either founded as pure EV companies or are currently transforming into one. Therefore, an analysis of every single company that competes with Tesla in any form, would go beyond the scope of a master thesis and would only allow a very superficial and detail-lacking analysis without comprehensive expert consultation. Adding on to that, the literature review has already shown that the main incubator of new pure EV companies is located in China and presented multiple existing studies that analyze their competitive relation to Tesla. This represents an already researched, but not fully understood, field of the EV industry. The German competitors, in contrast, have not yet been comprehensively compared to Tesla in any academic journal which represents the research gap that this thesis is focusing on. Thirdly, as presented in the introduction, the German competitors are potentially the most relevant competitors of Tesla due to their substantial industry experience and reputation in mass-production of cars of every product category in the market. Two German car manufacturers were excluded from this research for different reasons. Porsche is a premium manufacturer producing in low production volumes and therefore does not have to be considered in an analysis of mass production capabilities. Opel in contrast is not a stand-alone company anymore but is instead owned by the global Stellantis group for which an analysis of its global EV strategy would also be beyond the scope of this thesis. Furthermore, Opel's production volumes are also comparably low. With

the reasoning for the selection of analyzed companies provided, the design of research to examine these companies will be presented. As the research aim and corresponding research question focus on the concept of sustainable competitive advantages, the research has to be designed to appropriately examine company strategies. These internal strategies and production details are not necessarily publicly available and cannot be fully assessed by automotive consultants, general experts, and least of all the product end user. Consequently, the only people that are appropriate to be examined are actual employees of the companies that are mentioned to be at the focus of this research. Consequently, the first group of relevant people are Tesla employees and the second group are the entity of employees of the German manufacturers Volkswagen, Mercedes-Benz and BMW. To gain relevant information from these distinctive groups of employees, two main research methods will be performed to be used in the analysis & discussion of this thesis.

The first method is questioning each distinctive group of employees using a structured survey. Therefore there are not two versions of the survey for each group of employees but rather the perspective of both groups on the same coherence is being compared. This method represents the quantitative part of this research and serves two distinctive purposes. Firstly the identification of any business action the respondent deems a potential competitive advantage that Tesla possesses over its German competitors. A free choice of competitive advantages by the respondent is deliberately chosen over providing a predefined set of competitive advantages for assessment. The intention behind choosing this option is to enable the respondent to assess only the factors he has significant knowledge of. Employees of companies as large as these do not necessarily know enough about any aspect of their company and their competitors to provide this research with a useful assessment. Respondents are specifically told to only choose competitive advantages for which they have the confidence to be able to thoroughly assess them. The significant disadvantage of this decision is that each competitive advantage is not assessed by the total number of respondents in each group. The number of respondents that provided an assessment of the respective competitive advantages will be mentioned both in the visualization but also in the note underneath each diagram. Secondly, the respondents are to provide their assessment of each chosen factor by rating it according to the four dimensions of the VRIO framework. This framework by Jay B. Barney was among other purposes, developed to identify resources or capabilities that can be classified as sustained competitive advantages (Barney, 1995). He defined that in order to classify as such, the resource or capability must fulfil the requirements of being valuable, rare, inimitable and organized which define the name

of the framework. While rarity and inimitability refer to a comparison to the rest of the market and are self-explanatory in its content, the terms valuable and organized need to be further defined. The question that the dimension of value addresses is stated to be “Do a firm's resources and capabilities add value by enabling it to exploit opportunities and/or neutralize threats?” (Barney, 1995, p. 50). The corresponding question, the dimension of organized addresses is stated to be “Is a firm organized to exploit the full competitive potential of its resources and capabilities?” (Barney, 1995, p. 56). If a resource or capability does not fulfill the criterium of being organized, it is classified as an unused competitive advantage. If it does not fulfill the criterium of being inimitable, it is classified as a temporary competitive advantage but additionally, if that of organization is not fulfilled, it is classified as a temporary unused competitive advantage. Only if all four dimensions apply to a competitive advantage, it is classified as a sustainable competitive advantage. VRIO is a widespread and academically backed framework of analysis to identify sustainable competitive advantages which is why its use is perfectly appropriate and logical for this research.

The second method and purely qualitative method is that carefully selected employees of these companies are interviewed in form of a semi-structured expert interview. These enable a comprehensive and detailed interrogation of the employees, providing the research with open-ended data and a participants feelings, thoughts and beliefs. Furthermore, a semi-structured interview allows for the flexibility of asking second questions and further investigating interesting coherences. This qualitative approach represents the most appropriate format to gain information in maximum detail in order to be able to answer the research questions.

3.2 Data Collection

While the research design section only served the purpose of presenting and explaining the approach that this research is following to answer the research question, the data collection section will provide the details of how the respective data is conglomerated. While the primary data section will elaborate on the survey and expert interviews, the primary data covers the literature and website sources used in this thesis.

3.2.1 Primary Data Collection

The previously mentioned survey represents the first source of primary data and details will be provided on its structure and a short summary of the respondents will be provided. As already elaborated on, the survey serves the identification of potential competitive advantages and their individual assessment according to the VRIO framework. Therefore, the structure simply consists of two parts. Firstly, the option to freely pick any competitive advantages the respondent deems Tesla possesses over its German competitors. Secondly, the option is included to rate each of the five previously described dimensions of valuable, rare, inimitable and organized. To provide the maximum level of detail and base for comparison, the dimensions are presented to the respondent in form of a rating scale question. The used scale has five options with the first one representing that the respondent denies that the criterium applies to the competitive advantages. The values two to four represent a typical positive scale of how well the criterium applies to the competitive advantage. The intention of this structure is to allow for a detailed comparison of the assessment of both respondent groups which a simply yes/no scale would have not been able to provide. To examine whether the respondents assessed one dimension to apply to a competitive advantage, an acceptance threshold will be defined. If the average score, with a denial of applicability representing the score zero, of both respondent groups is below the value of 1.8 , the respective criterium is considered not fulfilled. Only if the condition average score >1.8 is true, the criterium is considered fulfilled. The case of 50/50 between denial and the best score of 4 as well the case of each option being chosen by 20% would result in the average score value of 2. Therefore the acceptance threshold is designed to capture that a majority of respondents assessed the criterium substantially more positively than those who either denied its applicability or only gave it the lowest score of one.

With the method of the survey established, a brief description of the respondents will allow for an assessment of the validity of the results. The size of the respective respondent groups of employees is 42 Tesla employees and 29 employees of German competitors. Of the employees of German competitors, 10 currently work at Volkswagen AG, 10 at Mercedes Benz, and 9 at BMW. Firstly, it has to be noted that the interviewed experts also participated in the survey and therefore make up six tesla employees and four employees of German competitors. The necessity and advantage of including them in the survey will be presented in the description of

the interview method. The remaining 36 Tesla employees were personally surveyed at the official opening ceremony of the Gigafactory 4 in Grünheide, Berlin. The first requirement for a respondent to be surveyed was for his or her department to be either strategy, procurement or production management. The second requirement was and an employment at Tesla of at least one year. This was deliberately chosen to be lower than for the employees of German manufacturers due to many Tesla being hired for the Gigafactory 4 which only started roughly two years ago. Nonetheless, many respondents were active for Tesla for a substantially longer time. Roughly 60% of respondents were affiliated with one of Tesla's strategic departments while the remaining 40% were roughly evenly split between the departments of procurement and production management. To comply with the strict non-disclosure-agreement of Tesla employees and to prevent any identification, no personal information like the respondent's age, home country or exact position was captured by the survey. The employees of German competitors were mainly surveyed by the expert interviewees who distributed a printed version of the survey to their colleagues. As the interviewees only work in either strategy or production management departments, the affiliation of this respondent group was very similar to that of the Tesla employees. As previously mentioned, their minimum affiliation to the company was defined to be two years. The interviewees were informed of that requirement and handed out survey papers accordingly. For the same reason of strict non-disclosure agreements and anonymity, these employees were also not asked for personal information which prevents a department breakdown.

The expert interviews followed a structure that is deliberately chosen to be as close to the survey structure as possible. As already mentioned all interviewees also participated in the survey which was performed verbally and represented the first part of the interview. In the case of the interviewees from German manufacturers, this also served to train the employees to be able to explain the VRIO framework and the survey methodologies to colleagues that would participate in the survey. The competitive advantages the interviewee freely chose would serve as the structure for the interview that followed. Each dimension of the presented VRIO framework represented one point of questioning for each of the chosen competitive advantages. Similar to the survey, this approach ensured the interviewee's competence in the respective business area and therefore his assessment. Furthermore, it enabled the content of the expert interviews to be highly comparable to the results of the survey. After this structured part of the interview, unstructured questions provided another opportunity to gain further knowledge about the researched coherence.

In order to offer an assessment of the validity and relevance of the interviewed employees, a brief description of their position and competence will be provided. Likewise, a major limitation was the provision of full anonymity to the interviewees which was executed with a specially developed non-disclosure agreement. While allowing this research to have as much internal information as possible it prevented any quantitative models or interviewee descriptions that would include any form of personal information like exact age or position. For this reason, the description of the interviewees will be presented in a more summarizing form. Figure 1 provides an overview of the interviewees and from here on, the interviewees will be identified by their respective interviewee ID. The average age of Tesla interviewees is roughly 39 years and the average affiliation with Tesla is roughly five years. The interviewees with the longest employment at Tesla are interviewees one and two who both worked at Tesla for more than 8 years and worked at multiple company locations. Both of these employees were chosen for their significant experience and competence on any of Tesla's strategic considerations. Interviewee three is currently working at Gigafactory 3 in Shanghai and provided the perspective on how the production start of Gigafactory 4 would affect production at his factory and which strategic advantages would arise from that. The three Tesla employees that are currently employed at the newly opened Gigafactory 4 Berlin are comparatively new employees but their minimum year of affiliation provided sufficient expertise about Tesla strategies that are deployed in Germany. Furthermore the employment of interviewee four at a Tesla procurement department and interviewee six at Tesla's production management, each offered a unique perspective of the strategies of those departments. The interviewees from German manufacturers in contrast are on average 56 years old and employed at the respective manufacturer for an average of 14 years. Therefore, the objective of selecting rather experienced interviewees to provide a comprehensive overview of each manufacturer's strategy in comparison to Tesla is fulfilled. These interviewees were mainly chosen for their long experience and consequent competence but also for their position which in any case was closely related to the EV strategies of the respective manufacturer. Furthermore, each of the German employees has a managerial position. Interviewee eight's position is in contrast to interviewees seven, nine and 10 directly related to the production process which allowed him to provide relevant details on upcoming EV production at the Volkswagen AG.

Figure 1

List of the 10 interview partners of the semi-structured interviews

ID	Company	Current country	Department	Interview Justification
1	Tesla Inc.	United States	Strategy	Overall global Tesla strategy
2	Tesla Inc.	United States	Production	Battery production and sourcing
3	Tesla Inc.	China	Strategy	Comparison Giga 4 Berlin / Giga 3 China
4	Tesla Inc.	Germany	Procurement	German sourcing strategy, IOB materials
5	Tesla Inc.	Germany	Strategy	Overall German Tesla strategy
6	Tesla Inc.	Germany	Production	Innovation in production processes
7	Volkswagen AG	Germany	Strategy	Overall Volkswagen EV strategy
8	Volkswagen AG	Germany	Production	EV production strategy & Sourcing
9	BMW(Bayrische Motoren Werke AG)	Germany	Strategy	Overall BMW EV strategy & Production
10	Mercedes-Benz	Germany	Strategy	EV strategy & Current technology

3.2.2 Secondary Data Collection

This review of secondary data will include a brief summary of the examined literature, as well as an assessment of the quality and appropriateness of the literature. The introduction used several sources from reputable websites as well as from Tesla's homepage itself and its quarterly reports. In the section on theoretical background, only two sources are used that are both books by Michael E. Porter. These are highly reputable in the field and only serve to provide the knowledge base of the concepts that this thesis is seeking to examine. As established in the introduction and literature review, academic research on Tesla is very limited and was published in three main periods with none or almost none publications in between those periods. When reviewing the literature on Tesla, it also became evident that even though uncountable articles and opinion pieces in non-scientific sources exist, the number of research pieces that were peer-reviewed and published in academic journals is highly limited. Potential explanations include the comparably recent success of Tesla and its sheer speed of changing and redeveloping company factors that might be of interest to academic research. Nonetheless, the literature review was defined to have the objective of presenting an overview of the academic research on the defined topic. Therefore, with the exception of two internet sources to provide

a more up-to-date perspective on a coherence examined by one research, every used source can be identified as an A-grade source. In total, the literature review has therefore reviewed 12 A-grade academic research papers on the topic of Tesla. Four of the papers were published in the journal *Management and Organization Review* representing a significant share of the total research on the topic. Due to the established scarcity of research on Tesla, four papers from journals that are not considered business focuses were included in the literature review. Another research that can be considered A-grade is used in the methodology section to introduce the VRIO framework which will be used in the analysis section. Besides that, other sources that were examined in the literature review will be briefly revisited in the analysis & discussion section to serve as a comparison or source of further information. Furthermore, the conclusion, limitations and future research section will compare the achieved results to the existing comprehension of the research field that was established in the literature review. No additional new sources will be introduced in the remainder of this thesis.

4 Analysis & Discussion

The analysis as the main part of this thesis will combine the results obtained by the survey and the 10 semi-structured expert interviews to answer the defined research questions. Following the research question, the analysis part will include two main parts. Firstly, the list of competitive advantages that resulted from the survey will be presented to provide the basis for further analysis. Secondly, each of these competitive advantages will be comprehensively analyzed with two main analytical tools. While the visualization of the rating scale questions of the VRIO framework will provide the quantitative results, the knowledge gained from the 10 expert interviews will provide the qualitative results. The analysis will include one specific section per competitive advantage to provide a comprehensive understanding of each factor. Combining these two distinctive results will enable the analysis to answer the second research question by classifying each competitive advantage either as a sustainable competitive advantage or one of two other previously described categories. To conclude these classifications into one comprehensive assessment of Tesla's strategy in mass production of electric vehicles, the last section will provide a summary as well as a figure combining all classifications and their average scores for which an explanation and an acceptance threshold were previously defined.

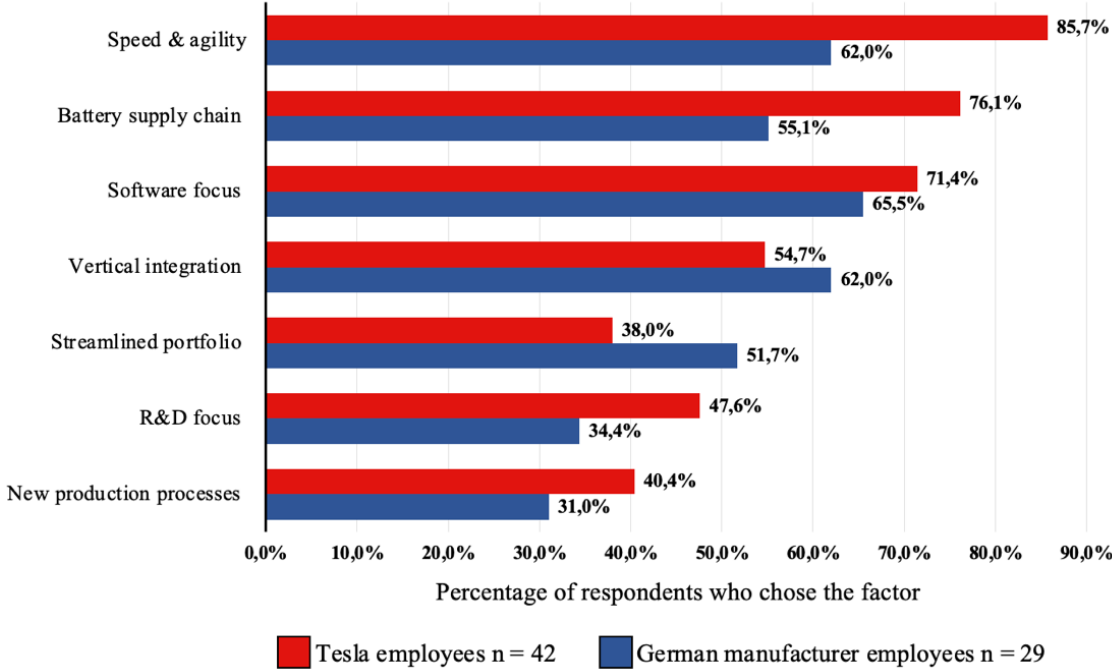
4.1 Identification of Competitive Advantages

As outlined in the methodology section, the survey respondents were allowed to freely choose any competitive advantage that they deemed a potential competitive advantage of Tesla over its German competitors. The total number of competitive advantages the respondents identified is 42. Through conglomeration of closely related factors, this number was reduced to 21. To filter this variety of competitive advantages, three requirements for their inclusion in this analysis were defined. Firstly, they had to be logically related to the mass production of electric vehicles. This requirements lead to the exclusion of factors like Tesla's supercharger network which can be considered competitive advantages of Tesla's products but not of Tesla's mass production capabilities of EVs. Furthermore, as defined in the research gap section and the literature review, such factors were already partly examined by the existing literature. Secondly, they are required to be factors that are considered economically relevant and analyzable factors. This led to the exclusion of the competitive advantage of Elon Musk himself who arguably does have a severe impact on the brand image and brand awareness, but is neither analyzable as a competitive advantage nor relevant for this research. These two first requirements further reduced the number to 12 factors. The last requirement to be applied is the percentage of the two surveyed groups of Tesla employees and German manufacturer employees who chose the respective competitive advantage. A comparison of these percentages revealed that said percentage dropped significantly from the seventh-highest average of 35,7% between the two groups to the eighth-highest average of only 18,1%. This represents a substantial reduction in significance within the collected data. Furthermore, the resulting number of respondents who provided an assessment of this eighth factor and the ones with even lower averages is not sufficient to provide an appropriate analysis using the defined methods of analysis. Therefore, the analysis includes the seven competitive advantages that fulfilled the requirements and still offered significant results while five competitive advantages with an average occurrence of 18,1 % or lower are excluded from the analysis. This exclusion also relates to the defined diction of the first research question to only include relevant competitive advantages, for which the excluded factors are argued to not be relevant due to their low occurrence in the collected data. Therefore, the relevant competitive advantages Tesla uses in mass-producing electric vehicles are concluded to be the following seven in decreasing order of their average occurrence in the data between the two respondent groups: (1) Speed & agility, (2) Battery supply chain, (3) Software focus, (4) Vertical Integration, (5) Streamlined Portfolio, (6) R&D Focus, (7) New

production focus. Consequently, these seven factors represent the answer to the first research question and the base for the second research question of classifying them as either sustainable competitive advantage or one of two other previously mentioned categories. Figure 2 provides the data on the occurrence of these seven factors in the data, respectively how many Tesla employees or German manufacturer employees chose and assessed each competitive advantage ordered by their average occurrence in both groups.

Figure 2

Percentage of survey respondents who chose and therefore assessed the respective competitive advantage Tesla has over its German competitors in the mass production of electric vehicles



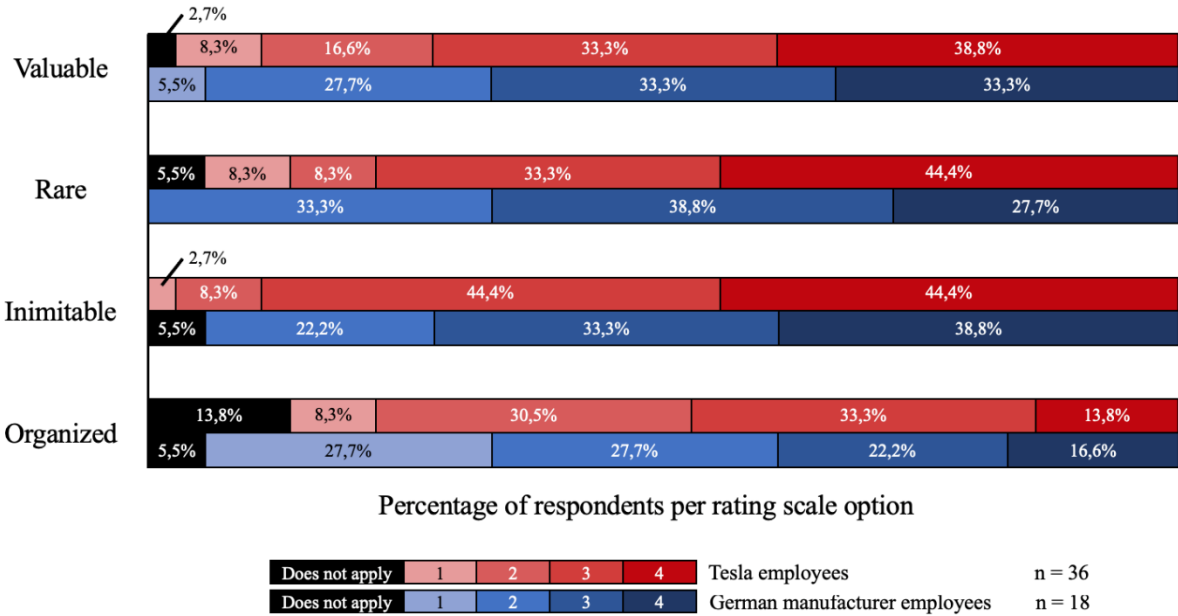
Note: The number of Tesla employee respondents is 41 and that of German manufacturer employees is 29

4.2 Speed & Agility

The competitive advantage of “Speed & Agility” conglomerates all responses that relate Tesla to an unusually high speed in business actions. These include four main aspects of how Tesla acts as a company. Firstly, its development of strategies and product improvements as well as how quickly they are implemented into the various parts of the company. Secondly, the speed with which Tesla is able to negotiate and finalize favorable contracts with parties like governments, suppliers and other allied companies. Thirdly, Tesla’s operating speed regarding the construction and commissioning of new facilities and all related required business actions. Fourthly, the agility and flexibility in adapting the beforehand mentioned aspects to changing circumstances. Despite covering a wide range of business actions, “Speed & Agility” describes one significant and specific part of Tesla’s strategy that promotes high tempo in all decisive actions. For the purpose of a more detailed analysis, Figure 3 displays how those respondents who chose this factor, assessed it in the extended VRIO framework.

Figure 3

VRIO framework analysis of “Speed & agility” comparing the percentage of respondents of Tesla employees and German manufacturer employees per rating scale option



Note: Number of respondents per category is provided in the bottom right corner (36 Tesla employees, 18 German manufacturer employees)

In summary, the evaluation of the VRIO framework provided in figure 3, shows surprising consistency in high rating scores for all four aspects. Both Tesla employees and German manufacturer employees largely rate speed & agility as valuable, rare, inimitable and organized and assessed with scores of three and four. Only a small percentage of respondents denied the applicability of the dimension to the competitive advantage with the only outlier being represented by 13,8% denying its organization. Nonetheless, all of the four average scores between the two respondent groups are well over the defined acceptance threshold and the competitive advantage is therefore classified as a sustainable competitive advantage.

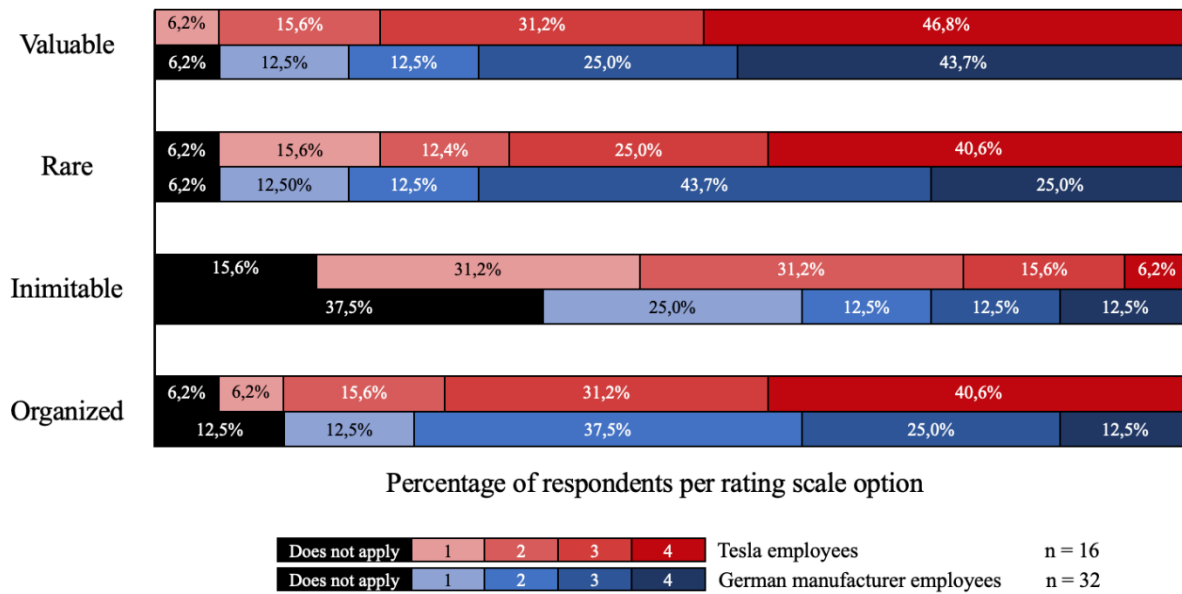
The largely positive assessment aligns with the results obtained by the expert Interviewees. Each of the 10 interviewees mentioned at least one and most even mentioned multiple example situations of him or her being very impressed by Tesla's operating speed. The prime example for interviewed Tesla employees is the speed of internal decision making and how fast decisions cascade down until implementation. The interviewed German employees in contrast offered a very different perspective. Three of the four German manufacturer interviewees complained about the exact thing, Tesla employees were praising: How slow strategies and decisions move back and forth through several management levels until action is taken. Regarding construction times, Interviewee three stated that "I was in Shanghai for the whole Giga 3 construction. The speed we accomplished on that site was specular. I'm not aware of any other car factory of that size being built that fast". Furthermore, a suitable conclusion was provided by interviewee seven who stated that "Tesla seems to be doing most things at start-up speeds. Volkswagen is just too large and too complicated to ever be like that".

4.3 Battery Supply Chain

While the designation of this competitive advantage seems self-explanatory, it has to be noted that this section does not examine the production or handling of the battery pack which represents the outer shell of the battery, but only the inner battery cells that make up the majority of the battery and determine its performance. Figure 4 will provide the survey results of the VRIO analysis for the competitive advantage of the battery supply chain.

Figure 4

VRIO framework analysis of “Battery Supply Chain” comparing the percentage of respondents of Tesla employees and German manufacturer employees per rating scale option



Note: Number of respondents per category is provided in the bottom right corner (23 Tesla employees, 23 German manufacturer employees)

An analysis and visualization of the resulting VRIO framework in figure 4 show that only for the dimensions of valuable and rare, only a maximum of 6,2% denied the applicability of value and rarity and overall provided a largely high score in those dimensions. In contrast, imitability was stated to not apply to Tesla’s battery supply chain by 15,6% of Tesla employees and a substantial 37,5% of German manufacturer employees. Besides that, a larger share of both respondent groups scored inimitability at scores of one and two, rather than three or four. Thus, the average score of Inimitability of 1,652 of Tesla employees and 1,375 for German manufacturer employees does not reach the defined threshold and the competitive advantage is therefore assessed to not be fully inimitable. Despite the scores of organization being very positive, Tesla’s battery supply chain must be classified as a temporary competitive advantage due to its assessed imitability.

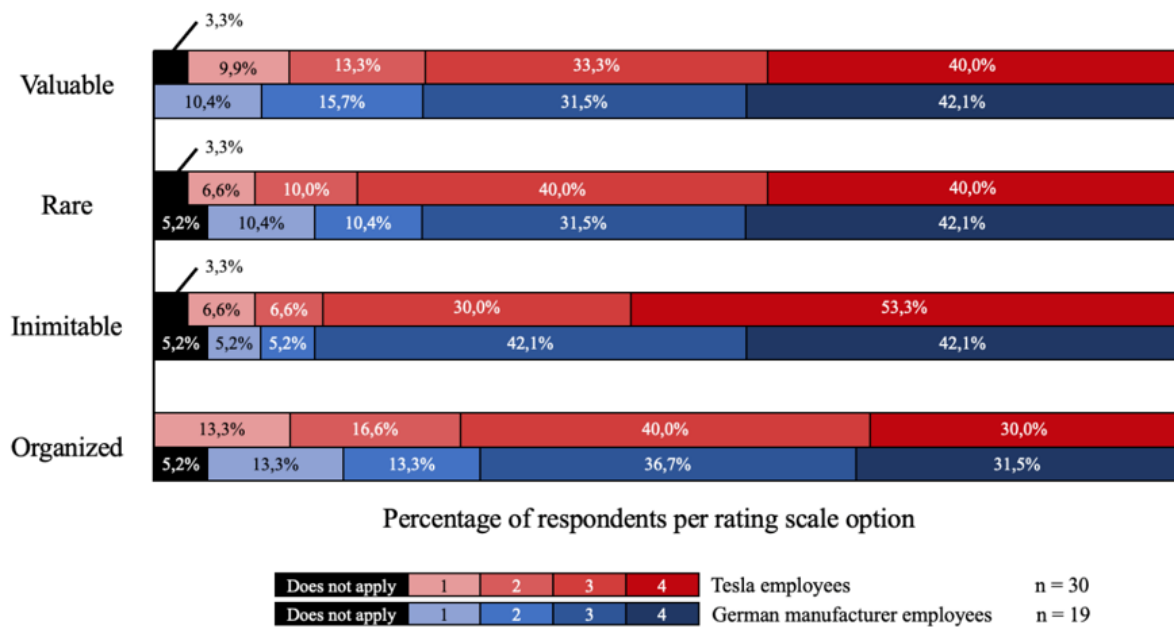
The results of the expert interviews provide the qualitative explanation for the imitability of Tesla's battery supply chain. Five of the six Tesla interviewees stated the development of the in-house production of Tesla's new battery cell in the 3680 format in Fremont, USA and at the new Gigafactory Berlin to be a major new development in the industry. Nonetheless, they all coincided in denying its total inimitability for which interviewee two stated: "It is innovative technology but with the rapid current development I do not expect the Germans to lack behind more than a year or two". German competitors likewise provided explanations like "The German companies are all seeking to diversify and vertically integrate it (the battery supply chain) but only timely aligned with new factories that are being planned for the next years (Interviewee 7). Overall, eight of the ten interviewees (except for interviewees five and eight who did not provide information on the factor) concluded a high relevance of this competitive advantage for the mass production of electric vehicles.

4.4 Software Focus

Software focus as the third competitive advantage to be analyzed is defined as Tesla's strategy regarding full inhouse development of software. This includes a fully integrated connection and control of all relevant car parts by one comprehensive software as well as Tesla's continuous over-the-air updating of all cars. Excluded is the infotainment software because it possesses only neglectable relevance in regard to production.

Figure 5

VRIO framework analysis of “Software focus” comparing the percentage of respondents of Tesla employees and German manufacturer employees per rating scale option



Note: Number of respondents per category is provided in the bottom right corner (30 Tesla employees, 19 German manufacturer employees)

The results of the VRIO analysis that figure 5 visualize provide an overall positive assessment of the four dimensions regarding Tesla’s software focus in comparison to the capabilities of German manufacturers. No dimension has more than 5,2% of respondents stating that it does not apply to software focus and neither average score of both respondent groups is lower than the defined threshold for any of the four dimensions. In fact, a substantial average of 40,13 of respondents gave the competitive advantage the highest score of four. Consequently, Tesla’s software focus can clearly be classified as a sustainable competitive advantage according to the VRIO framework.

Likewise, the assessment of expert interview results provided the same conclusion. Arguments towards Tesla’s software focus were given in two main categories. Firstly, interviewees explained that its in-house software production enabled Tesla to adapt its software for computer chips and semiconductors differently from those that were initially planned for production. On the impact of this coherence, it was stated that “Being able to adapt production to a different

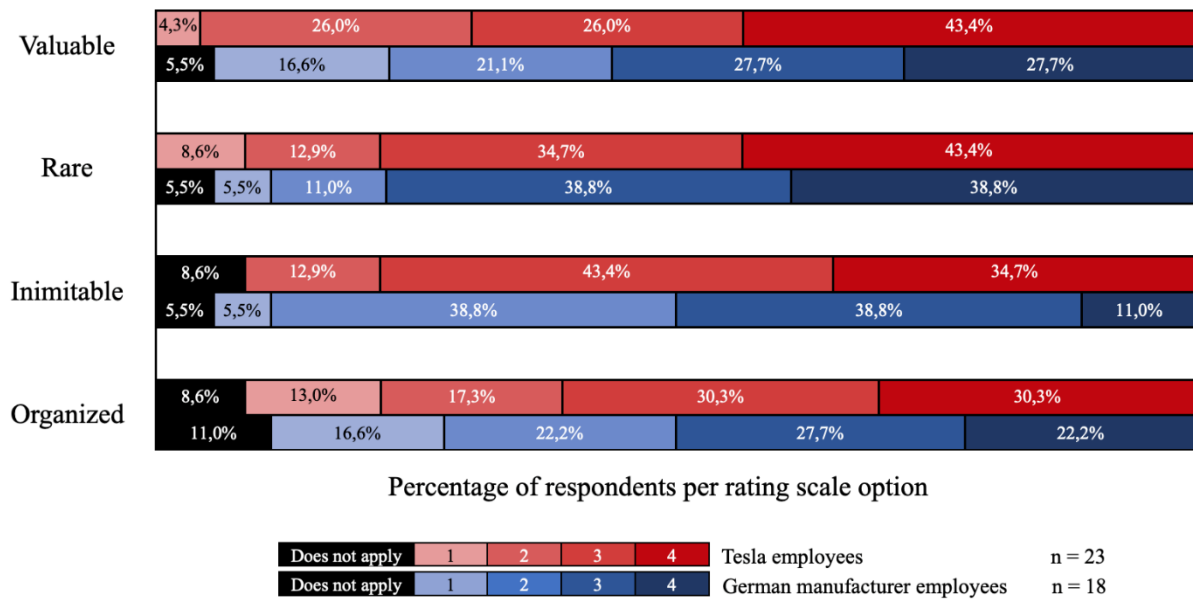
chip model literally saved us from stopping production because of missing chips” (interviewee one). Secondly, two Tesla employees currently working in China and Germany provided the example of over-the-air updates fixing battery management systems. Interviewee three described that “after putting the new CATR (Chinese battery manufacturer Contemporary Amperex Technology Co.) battery cells into the Model 3, it would sometimes report wrong battery charging levels and my coworkers told me it was even worse on cold days when they tested it”. According to interviewee five, hundreds of Model 3’s had those same problems in Germany because they were imported from Gigafactory 3 Shanghai but stated that “The software update that was published a month later fixed the problems and I’ve honestly never heard of any complaints after that.”. This results in Tesla being able to sell and export cars even though they are not fully developed which arguably no other car manufacturer, especially the German ones would not do. The interviewees from German competitors that provided information on the topic focused on how they knew that Tesla didn’t have the same supply problems for chips because of Tesla’s software adaptation. Especially Interviewees nine and ten described a switch to higher-margin models because they often did not have the right chip and semiconductor supply. Regarding imitability, interviewee seven who works at Volkswagen stated that “I do not think we can replicate their (Tesla’s) IT team, we would be happy if we would have 60% inhouse production by 2025 – that’s our official goal.”

4.5 Vertical Integration

The term vertical integration describes performing parts of the value chain in-house or inclusion of such into one’s company, that is typically not part of the core business of the respective industry. The relevant differentiation at this point is between forward / downstream integration towards the retail aspect of the product and backward / upstream integration towards component manufacturing and purchase of raw materials. As only competitive advantages that relate to the production of EVs are considered, only the backward / upstream vertical integration is relevant for this analysis. Therefore, the in-house production of car components and direct purchase of raw materials will be included but the online retail model and Tesla-owned showrooms are excluded.

Figure 6

VRIO framework analysis of “Vertical Integration” comparing the percentage of respondents of Tesla employees and German manufacturer employees per rating scale option



Note: Number of respondents per category is provided in the bottom right corner (23 Tesla employees, 18 German manufacturer employees)

Analyzing the results obtained by the survey, represented in figure 6, it becomes evident that the dimensions of value and rarity are rated fairly positively while inimitability and organization appear as more debatable. Inimitability only shows a maximum of 8,6% denying the application of the dimension to vertical integration but a large share of German employees assessed it with a score of two leading to an average score between the two groups of 2,691. The dimension of organization shows 8,6% and 11% denial of applicability of Tesla employees and German manufacturer employees respectively as well as more than 30% of respondents assess it with either score of one or two. Nonetheless, the average score of 2,463 for organization is above the threshold and the factor is therefore classified as a sustainable competitive advantage.

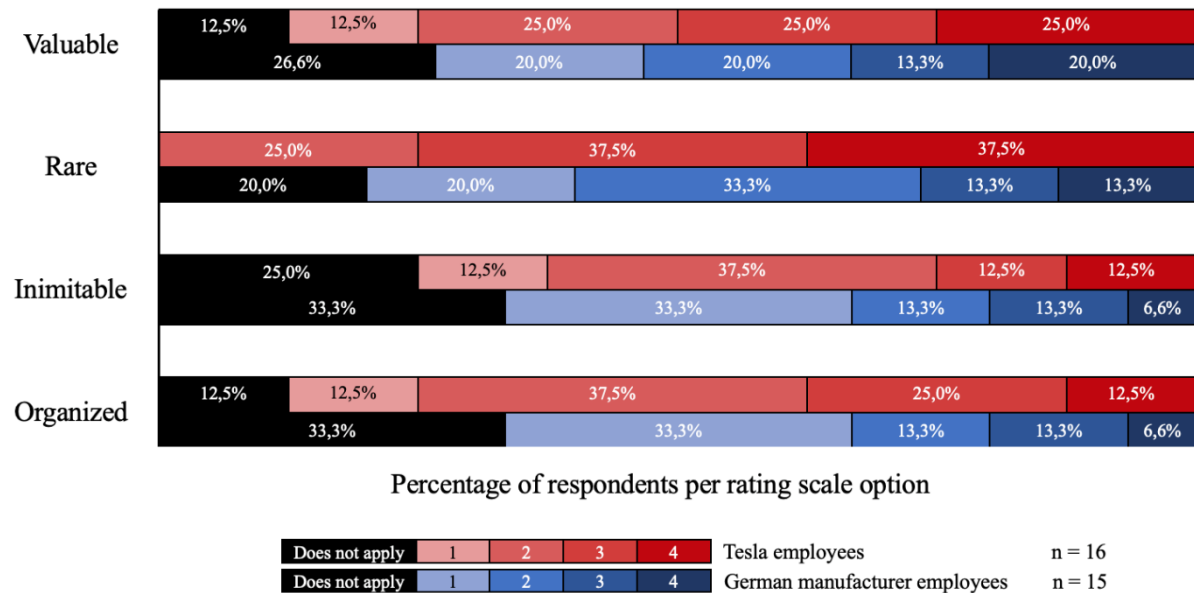
Both groups of interviewees that assessed this competitive advantage coincided in pointing out how different Tesla's approach is from that of German competitors. While interviewee nine stated that "BMW uses a just-in-time component delivery from suppliers to assembly lines which is the normal concept in Germany", interviewee six described that "Gigafactory 4 (located in Germany) was designed to produce the large majority of parts inhouse and even the battery will soon be produced 100 meters away from the assembly line". The German approach of a variety of smaller suppliers is repeatedly described to have the advantage of lower investments for the manufacturer but also to have the disadvantage of high dependencies and timing relevance. On that topic, interviewee eight stated that "as long as all suppliers are delivering, it (just-in-time delivery) works perfectly but as soon as something is missing, production has to stop immediately". Interviewee one from Tesla US. in contrast stated that "We (Tesla) just do not have the time to wait for suppliers to open up shop next to new facilities. That is why we engage in alliances with companies like Panasonic but small suppliers are avoided for production essential components". In conclusion, Tesla focused on maximizing the control it has over every part of the value chain which enables an earlier production start at new facilities and prevents supply chain bottlenecks and increases the company's supply chain resilience. German manufacturers trusted running system of multiple suppliers but their missing supply chain resilience evidently caused production stops. Thus, this sustainable competitive advantage has a twofold positive effect on Tesla's ability to mass-produce EVs.

4.6 Streamlined Portfolio

This competitive advantage refers to survey results and interview results that pointed toward a deliberate strategy of Tesla to streamline their portfolio in two ways. Firstly, Tesla's focus on only two models X and Y for mass production. Secondly, by highly limiting the number of options like exterior / interior color, wheels, etc. to an option catalogue that is substantially smaller than that of the German manufacturers.

Figure 7

VRIO framework analysis of “Streamlined Portfolio” comparing the percentage of respondents of Tesla employees and German manufacturer employees per rating scale option



Note: Number of respondents per category is provided in the bottom right corner (16 Tesla employees, 15 German manufacturer employees)

As the VRIO analysis in Figure 7 shows, the competitive advantage streamlined portfolio is also highly disputed. While the value dimension already includes a substantial share of respondents denying the applicability, it is overall rated above the acceptance threshold with an average score of both groups of 2,087. The inimitability dimension in contrast does not surpass the threshold with an average score of 1,506. This is would consequently classify Tesla’s streamlined portfolio as a temporary competitive advantage but the dimension of organization shows a surprisingly low average score of 1,693 is therefore below the threshold. This results in this competitive advantage to be classified as a temporary & unused competitive advantage.

In alignment with these results, the experts were split into two main opinions. Firstly, that a streamlined portfolio bears a significant advantage in mass production of electric vehicles for which interviewee two stated “This low variety of options makes so many production steps easier to implement in our factories. Also, it enables us (Tesla) to manufacture a larger share of components inhouse which has other positive effects”. Secondly, that only a widely spread car portfolio can serve the entire market for which interviewee ten noted that “We (Mercedes) are

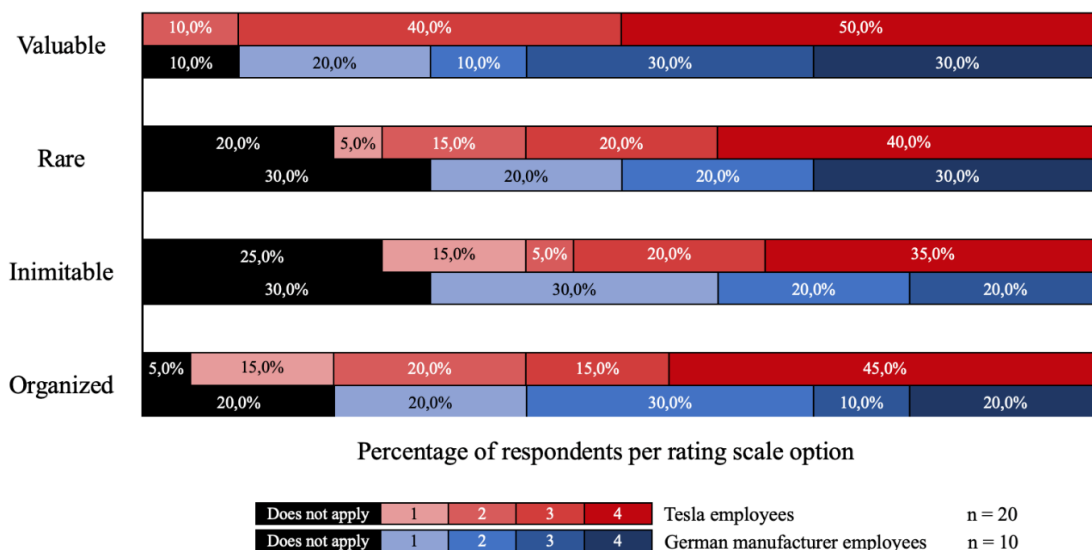
required by the market to have that many models, Tesla must be leaving market share on the table with these few models”. Furthermore interviewee eight stated that “Tesla’s low number of options is a problem for me. I don’t really understand it and it would definitely prevent me from buying one.” This represents a potential explanation for the low organization value and the results suggest that respondents think that Tesla does not reach its full potential. While clearly being a competitive advantage for mass EV production, especially the interviewees of German manufacturers related Tesla’s streamlined Portfolio to significant disadvantages.

4.7 R&D Focus

The competitive advantage of Tesla’s research and development focus is a self-explanatory term but requires further definition. Various online sources as well as the experts interviewed for this thesis define Tesla to have high R&D spending per car sold. Online sources put that value at \$2984 per car sold and compare it for example to \$1186 for Ford and \$1063 for Toyota while interviewees two and five did not state an exact number (Lambert, 2021). While the exact numbers are yet to be officially confirmed the mentioned two of the six interviewed Tesla employees were evidently aware of Tesla leading this statistic. Thus, the R&D focus bears relevance and its significant occurrence in the survey data underlines that.

Figure 8

VRIO framework analysis of “R&D Focus” comparing the percentage of respondents of Tesla employees and German manufacturer employees per rating scale option



Note: Number of respondents are 20 Tesla employees and 10 German manufacturer employees

The visualization of the VRIO analysis presented in figure 8 shows how disputed the competitive advantage was assessed to be by the surveyed employees. While the value dimension proves Tesla's R&D focus to be largely assessed as valuable for the company, the remaining three dimensions are fairly negatively rated. With an average score for rarity between the two respondent groups of 2,175, this dimension is above the threshold. Inimitability in contrast is assessed at an average score of 1,775 and is therefore below the defined threshold of acceptance. Therefore, the competitive advantage is classified as a temporary competitive advantage but it has to be noted that it is very close to the classification of competitive parity.

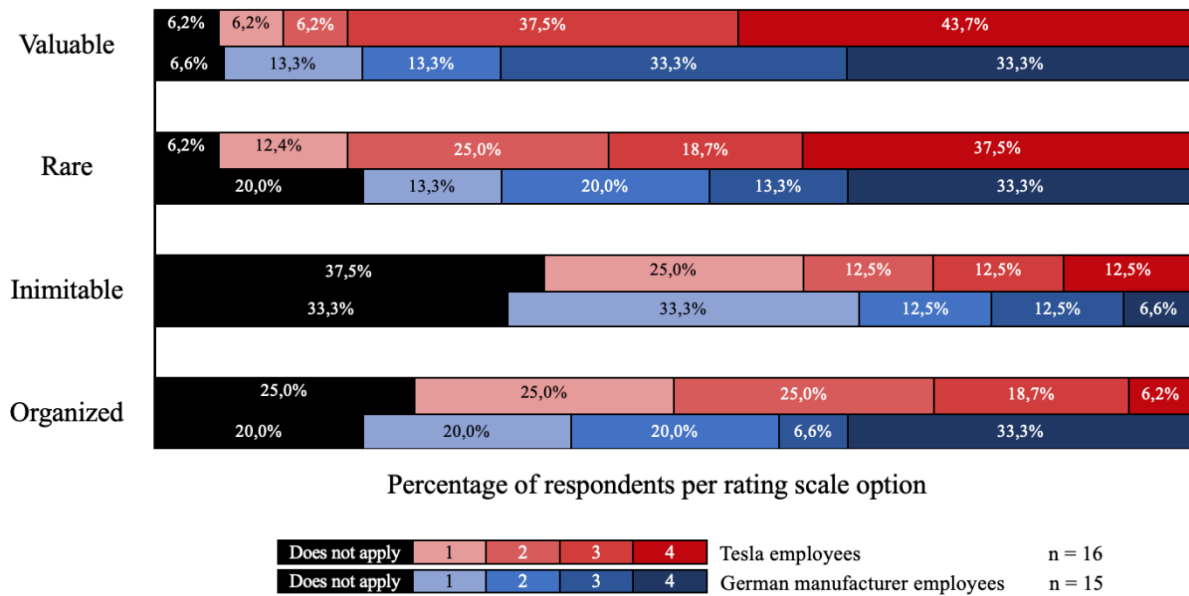
As a potential explanation for the low scores in rarity and inimitability, the perspective of the interviewed employees of BMW and Volkswagen are most representative. Both interviewees seven and nine described in recent years, the relevance of electromobility and respective R&D investments grew immensely and that they are continuously catching up to Tesla's level of technological achievements. Furthermore, interviewee 10 stated that "In my opinion, when the Model S came out they (Tesla) were far ahead but with cars like the Mercedes EQS I would say we have reached or surpassed a fair share of the technology". Overall, the interviewed Tesla employees praised Tesla's R&D effort and spending but more than half admitted it to be imitable in the short- or mid-term.

4.8 New Production Processes

The last competitive advantage called new production processes is self-explanatory but requires a definition of which production aspects are included. Firstly, the automation of parts of the production process that are typically still carried out manually by large parts of the industry. Secondly, the deployment of new types of machines that offer significantly higher speed of production.

Figure 9

VRIO framework analysis of “New Production Processes” comparing the percentage of respondents of Tesla employees and German manufacturer employees per rating scale option



Note: Number of respondents per category is provided in the bottom right corner (16 Tesla employees, 15 German manufacturer employees)

Figure 9 provides the visualization of the VRIO analysis of Tesla’s new production processes which shows a fairly positive assessment of the dimension of value. Despite 20% of German manufacturer respondents stating that rarity does not apply to Tesla’s new production processes, the remainder of both groups assessed it positively. Thus, the average score of both respondent groups is 2,474 and surpasses the threshold. The dimension of inimitability was assessed by one third or more of the respondents to be applicable and therefore does not reach the acceptance threshold of with an average score of 1,298. Consequently, the factor is classified as a temporary competitive advantage.

For the competitive advantage of new production processes, Tesla employees were mainly giving two examples. Firstly, the previously mentioned increased automation for which interviewee four stated “The acquisition of the German company Grohmann Engineering really helped in increasing automation at Gigafactory 4 (Berlin) compared to previous production lines”. Another example was provided by interviewee five who mentioned “New machines like

the Gigapress are really helpful. With those, we can press the entire front section of the car out of aluminum in no time.” The employees of German manufacturers coincided in describing new production methods as a typical industry development for which interviewee seven pointed out that “That (New production processes) happens all the time in Germany – BMW might outdo us in one machine and then somebody else will outdo them and so forth”.

4.9 Final Classification

The analysis & discussion of the various competitive advantage provided an in-depth examination according to the VRIO framework as well as an overview of how the 10 expert interviewees assessed the differences between Tesla and the German manufacturers. To provide a detailed visualization of the classification of Tesla’s competitive advantage in mass production of electric vehicles, Figure 10 will provide the classification as well as the color-graded average scores that resulted from the survey.

Figure 10

Final classification of competitive advantages according to the VRIO Framework

Strategic factor	Value Score	Rarity Score	Inimitability Score	Organization Score	Classification
Speed & Agility	Ø 2,953	Ø 2,981	Ø 3,148	Ø 2,202	Sustainable competitive advantage
Battery Supply Chain	Ø 3,027	Ø 2,732	Ø 1,513	Ø 2,529	Temporary competitive advantage
Vertical Integration	Ø 2,803	Ø 3,056	Ø 2,691	Ø 2,463	Sustainable competitive advantage
Streamlined Portfolio	Ø 2,087	Ø 2,461	Ø 1,506	Ø 1,693	Temporary (& unused) competitive advantage
R&D Focus	Ø 2,85	Ø 2,175	Ø 1,775	Ø 2,35	Temporary competitive advantage
New Production Processes	Ø 2,894	Ø 2,474	Ø 1,298	Ø 1,844	Temporary competitive advantage

Note: The scores present the average score, respondents of both groups assessed the competitive advantage with. The option of denying the applicability of one framework dimension to a competitive advantages represents the value zero and the options one till four the respective value.

6 Conclusions

The research aim of this thesis was to examine whether Tesla possesses sustainable competitive advantages in the mass production of electric vehicles over its German competitors. While the introduction provided the relevance of Tesla's Gigafactory 4 Berlin and the consequent appropriateness of a comparison to German car manufacturers, the literature review revealed the research gap of an examination of Tesla's production capabilities. As the methodology outlined, the most appropriate method of analysis was found to be the examination according to Barney's VRIO framework using 10 semi-structured interviews and a survey with 71 respondents. The first part of the analysis answered the first research question by establishing seven relevant competitive advantages from the survey results which the second part sought to classify. Combining the quantitative assessment of competitive advantages through the survey results with the qualitative assessment of the expert interviews, yielded a comprehensive and detailed argumentation that enabled the factor's classification. Of the seven competitive advantages, the factors of Tesla's battery supply chain, its R&D focus and new production processes are classified only as temporary competitive advantages. While Tesla's streamlined portfolio is assessed to be an unused temporary competitive advantage, the analysis was able to identify two sustainable competitive advantages. Firstly, Tesla's speed & agility which refers to the company's high operating & decision-making speed as well as fast construction & commission of new factories. Secondly, Tesla's vertical backward integration of component manufacturing and future in-house battery cell production. These two competitive advantages, Tesla possesses in the mass production of electric vehicles over its German competitors, are based on the analysis performed in this thesis, classified as sustainable. Thus, this thesis provides a comprehensive understanding of Tesla's EV production strategy and how direct and relevant German competitors currently compare and will compare to it in the near future.

7 Limitations

As the research design outlined, the main methods of analysis used in this thesis are a survey with 71 respondents as well as 10 semi-structured expert interviews using the VRIO framework. The first obvious limitation of this methodology is the number of survey respondents and interview partners which provides a limit to the validity of the results. While both survey respondents and interviewees were selected with extreme care and under defined requirements, the expertise and knowledge of the selection can also represent a limitation. And despite the VRIO framework and the literature, it builds upon being highly reputable, the use of one main framework also limits validity and a more diverse and comprehensive analysis would require the inclusion of further frameworks.

8 Direction for Future Research

A potential direction for future research this thesis points towards stands in relation to both the identified research gap and the previously mentioned limitations. Firstly, as outlined in the introduction, the overall research and knowledge regarding Tesla's production strategy was found to be highly limited. Future research should examine this part of the Tesla phenomenon and can use the identified competitive advantages as a basis for further analysis. Secondly, as the limitations outlined, applying a larger variety of analytical methods and frameworks to this coherence and questioning a larger respondent group would create significant advances in the knowledge about the field and help to decrease the defined research gap.

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10 Appendices

10.1 Interview ID 1 Summary

(Gender neutralized summary due to personal demand)

As outlined in figure 1 and the methodology section interviewee 1 is an experienced employee at Tesla US with substantial experience at the company. The interviewee provided a variety of required knowledge on the factory locations in the US and what role they take in the global Tesla strategy. Especially the information on how the original Tesla location was created and evolved to what it is where very interesting to gain an understanding of how Tesla evolved over time. By providing his/her perspective of how the different parts of Tesla and its production facilities create value for the overall company, the dimension of value that is used in the VRIO framework really gained its fundament. Previously to the interview, I was not as aware of how many different smaller Tesla locations work together to create the end-product respectively various end-products as Tesla expanded for other business areas like battery home storage. He/she shed light on the facilities beyond the Gigafactories that receive the most recognition and media attention. Besides the pure production facility, he/she also elaborated on how a whole ecosystem is created around Tesla's main locations. This includes employee housing just as much as allied companies, the limited number of not vertically-integrated suppliers as well as research institutes. His/her perspective on the overall competitive advantages of Tesla was mostly focused on factors that the end customer is able to experience which is why the interview let him/her focus on this very different production aspect. On the topic of vertical integration his/her detailed knowledge of the smaller and often overseen parts of the company was very influential. While he/she pointed out that EVs do in fact have a substantially lower number of moving parts, the level of Tesla's vertical integration balances this factor right out. According to the interviewee, many smaller interior parts and issues of ensuring build quality of interior aspects posed more substantial hassle and effort for Tesla than was publicly admitted. In addition to that, he/she elaborated on how much of Tesla's development time went into improving both vertically integrated components as well as production processes. Nonetheless, he/she added that as soon as Tesla figured out one technique or aspect of production it was fairly easy to implement it in most factories around the World. This was mentioned to be part of Tesla's speed which this thesis presents as a sustainable competitive advantage: As soon as the right technique or process is found, its being effectively copied for all comparative

coherences in other factories. According to him/her, the predefined process of how to build a new factory, production line or in-house component production, increases Tesla's overall speed substantially. As another main success factor, he/she pointed multiple times toward alliances like the battery production with Panasonic. This cooperation was stated to be highly effective and saved Tesla a fair bit of knowledge acquisition.

10.2 Interview ID 2 Summary

(Gender neutralized summary due to personal demand)

Interviewee 2 was really more of a tech and product design person interested in propulsion and driving technology. Furthermore, he/she emphasized how much he worked on topics like the design of production processes for electrical components. Especially the design and impact of the new Tesla battery cell in the 3680 format was a major topic during the interview. On most evaluations of competitive advantages, interviewee 2 could insert valuable knowledge of how new technologies like the battery cell will have a positive impact for Tesla. Despite his/her obvious conviction of Tesla's own technology he/she could still also provide his knowledgeable opinion of how German manufacturers compare in terms of technology. This valuable ability to objectively and honestly compare said competition also led to the quote that was used in the thesis. He/she noted on Tesla's battery technology that: "It is innovative technology but with the rapid current development I do not expect the Germans to lack behind more than a year or two". His/her perspective on Tesla's success mainly lied in smart product design and smart redevelopment of main automotive concepts. One of his/her main example which also found its way into the final thesis was on how product design positively results in less complex production facilities. On that regard, he/she notes stated that "This low variety of options makes so many production steps easier to implement in our factories. Also, it enables us (Tesla) to manufacture a larger share of components in-house which has other positive effects". Furthermore, he/she was able to provide substantial knowledge on which strategies Tesla deliberately incorporated into its product design in order to switch from lower-volume production of eg. Model S to full mass-production of Model 3.

10.3 Interview ID 3 Summary

(Gender neutralized summary due to personal demand)

In contrast to interviewees one and two who were mainly working in the States, interviewee three had spent the last years in Tesla's Gigafactory 3 in Shanghai, China. His most significant contribution to this thesis was on the one hand on the construction speed of Tesla in Shanghai and on the other hand on how new Gigafactory 4 Berlin has impact on his China location. Firstly, His/her accounts on how the Gigafactory in Shanghai was constructed in roughly one year were very valuable to gain an understanding how Tesla approaches projects like these. From preplanning every single aspect of the construction till how production typically starts, he/she was very knowledgeable about the whole process. He/she stated that the effort Tesla's puts in planning before the first stake is in the ground was a revelation to him/her. In previous jobs, he/she was confronted with a lot of uncertainty of what to do next in the process. At Tesla in contrast there was such a speed pressure that there was no time for any uncertainty. At times he stated, it felt like an IKEA instruction that was followed step by step until a whole factory was just suddenly there. Especially interesting was how he/she described how Tesla manages such step building approach. Apparently, every single step of construction is planned so precisely that multiple aspects are build and coordinated simultaneously with perfect alignment. He stated that "No one had to wait for another part to be completed because everything was so well-aligned". Furthermore, he/she also stated how impressed he was by stating that "The speed we accomplished on that site was specular. I'm not aware of any other car factory of that size being built that fast" which was used as a significant quote in the analysis section. Secondly, another main part of his contribution was explaining how Gigafactory 3 Shanghai split its production time to account for exports to Europe. The first quarter of every year was when all production was only focused on export production. He/she stated that during this time, large transport ships would continuously transport new Model 3 and Y to Europe. When asked about the average transit time he stated it to be a little over 30 days in most cases. He/she went on to explain how this transit time was a financial issue for Tesla and how he/she is happy that the new Gigafactory 4 Berlin will finally solve that issue and also let Gigafactory 3 fully focus on the Chinese market.

10.4 Interview ID 4 Summary

The fourth interviewee was the is the only Tesla employee I was able to interview that worked in a procurement department. He was hired specially for the Gigafactory 4 in Berlin and had a previous occupation in the German automotive industry which made him very valuable for the overall comparison of the thesis. He provided many interesting insights on how decision-making and management structures were different between Tesla and his former employer. He stated that he previously thought there was no other way of doing business than lengthy processes and a lot of unnecessary paperwork. After starting to work for Tesla, he stated that it was very surprising to him how Tesla worked on the inside. On that topic, it was very insightful to let the interviewee compare different smaller work aspects between Tesla and his former employee. Furthermore, he provided substantial insights on how Tesla is building up its procurement processes in Germany. I was especially surprised to get to know how strict suppliers must keep a relation to Tesla a secret. No supplier of materials or machines, even the very small ones, was allowed to state that they were supplying Tesla in any form. When being asked for the reason of handling it that way, interviewee four described that companies previously liked to brag about supplying such a new and innovative company. Furthermore, he explained that Tesla just has an overall strategy of keeping as much information as possible internal. This definitely also provided an explanation for why it was so hard to find information about German material and machine suppliers of the Gigafactory 4. The largest one which Tesla lastly ended up purchasing was another main aspect of the interview which also led to interviewee four being stated with a direct quote. He stated that “The acquisition of the German company Grohmann Engineering really helped in increasing automation at Gigafactory 4 (Berlin) compared to previous production lines”. This and his respective explanation provided valuable knowledge on how Tesla is increasing the automation of its production line with every new factory. The acquisition of Grohmann Engineering was stated to be already visible in the production lines and also to have a fair positive effect on internal production metrics.

10.5 Interview ID 5 Summary

Like interviewee four, interviewee 5 also worked at Gigafactory 4 and was specially hired shortly after the announcement of choosing the Grünheide location for production. But in contrast, she was not previously employed in the industry but rather transitioned from a very different field. The aspect she was most involved with was the overall Germany strategy of Tesla. Besides project management of the construction side, she also had major touchpoints with end customers through Tesla's delivery center in Germany. On that topic, she provided valuable information on how the delivery of Model 3 and Model Y worked in Germany. She described a pretty chaotic overall situation which stood in contrast to previous opinions I heard about internal processes at Tesla. Delivery of new vehicles happened partly at rented car parks and trucks with new vehicles came in such a high tempo that time for charging and cleaning the vehicles was always scarce. She heard of multiple complaints about Tesla's only being charged 30% at delivery which customers apparently expected to be handled differently. Furthermore, the interviewee provided information through her touchpoints with complaint management etc. . According to interviewee five, hundreds of Model 3's had those same problems in Germany because they were imported from Gigafactory 3 Shanghai but stated that "The software update that was published a month later fixed the problems and I've honestly never heard of any complaints after that.". This quote used within the thesis was a valuable insertion for the over-the-air updates that led Tesla to be able to solve the stated problem. Furthermore, her information on how the strategy was formulated to experiment with the new Gigapress machines made in Italy was also very insightful and led her to be included in another direct quote. She provided an account of what the machine is able to do and how it will be intended to speed up production, more precisely the casting of the main shell parts.

10.6 Interview ID 6 Summary

(Gender neutralized summary due to personal demand)

The Interview with interviewee six was unfortunately fairly time-constrained which is why he/she did could not provide as much information on Tesla as other interviewees. After completion of the survey and respective assessment of the competitive advantages, the main topic of discussion was the vertical integration in the Berlin Gigafactory but also the future in-house battery production. He/she provided many insights about how far the construction of this production facility currently is and that its expected to potentially even start production in 2022. The number of future employees in that facility was stated to be 2000-3000 in relation to 12.000 for the main Gigafactory building. When assessing the competitive advantage of vertical integration, he/she especially focused on how many components Gigafactory 4 Berlin actually produces itself. On that topic, he/she stated that “Gigafactory 4 (located in Germany) was designed to produce the large majority of parts inhouse and even the battery will soon be produced 100 meters away from the assembly line” which was a valuable quote to insert into the section on that competitive advantage.

10.7 Interview ID 7 Summary

Interviewee seven from the Volkswagen AG was arguably the most influential interview of all of the ten expert interviews. Not only did he provide content for three quotes I was able to use in the analysis, he also presented valuable information on VW’s EV strategy and how they plan to compete with Tesla. As established in the introduction, VW is arguably the most relevant competitor of Tesla with its ID.3 and ID.4 EV’s being highly successful in the Market. This model also represents the only EV models I have personally driven which caused them to be a major part of the interview. He was very convinced of these models as he was personally working on some of the strategies regarding these models. This provided the interviewee with many valuable insights on how these models were intended to be positioned in the market and with which models they were planned to compete with. While he didn’t deny that most EV owners are very split between the brands of Tesla and VW, he stated that many people would be highly interested in an EV of a manufacturer they already know well. He then went on to

describe VW's brand reputation as a major mass-production manufacturer with models like the famous Golf. The new EV's are designed to take over a comparable role in the market. The car that is perfectly enough for the wide mass of customers. On the topic of the overall comparison of Tesla vs. VW, his honesty and directness were really helpful for the understanding of differences. His quote that "Tesla seems to be doing most things at start-up speeds. Volkswagen is just too large and too complicated to ever be like that" provided the most significant admittance of Tesla bei

10.8 Interview ID 8 Summary

(Gender neutralized summary due to personal demand)

While interviewee seven who also worked at Volkswagen had very limited relation to the production, luckily interviewee eight was managing a small team within the production management of the company. He/she provided much internal information on how the production was affected due to the chip crisis. His/her statement on the just-in-time delivery system that "as long as all suppliers are delivering, it (just-in-time delivery) works perfectly but as soon as something is missing, production has to stop immediately" was really essential for the analysis. His/her description of instances where production had to stop temporarily due to missing components really provided a different perspective on the supply chain of German manufacturers. While he/she stated that the supply with most parts had been very easy for decades, he/she also stated the last two years to have been really challenging. The chip crisis was described to have had a substantial effect on Volkswagen's production which stopped for several months in the years of 2020 and 2021. The interviewee was aware of the fact that Tesla did not have as many limitations as VW but he stated his knowledge to be too limited for a direct comparison of the two companies. Interviewee eight was also one of the few interviewees who provided his personal opinion of Tesla's end product. While he/she generally stated that the overall design of Tesla cars was appealing to him/her, the opinion was also provided that "Tesla's low number of options is a problem for me. I don't really understand it and it would definitely prevent me from buying one.". His knowledge of production processes due to his respective affiliation at Volkswagen led him/her to state that he/she doesn't have an explanation of why Tesla's options are that limited. Especially for exterior colors, he/she wondered why Tesla wouldn't just double the options due to customer demand.

10.9 Interview ID 9 Summary

BMW's only representation was provided by interviewee nine who works in a high strategy position at the Bavarian car manufacturer. Due to my personal knowledge and affiliation to the brand, this interview was admittedly particularly enjoyable. The interviewee presented the entire EV strategy of the brand, which models they are launching with which intention as well as how their strategy will change in the future. He also provided valuable insight on how BMW was one of the earliest adopters of EVs in Germany with the early models i3 and i8. Nonetheless, he admitted that the company had long lost track of the market and how it now has changed to more normal looking and feeling EVs. This was also his explanation for launching cars like the i4 which are visibly not that different from the brand's combustion engine cars. Furthermore, the interviewee had an earlier affiliation with more production focuses departments which is why he was also able to provide insights into the main concepts of just-in-time delivery. On that approach, he stated that "BMW uses a just-in-time component delivery from suppliers to assembly lines which is the normal concept in Germany" which was used for the analysis section. Besides this timing supply chain concept, he also provided many insights about how production has changed at BMW over the last 10 years. He stated speed and efficiency to have substantially improved and that new facility for the production of EVs will be even more so. On that topic, he stated all the innovative power of BMW is put into the new EV models and their production. In his belief, the qualities of the brand will also be maintained in non-combustion-powered vehicles. He personally already drives an electric BMW and his opinion of how well it works and how usable it is was also valuable for this research.

10.10 Interview ID 10 Summary

The last interviewer with its affiliation to the very company that invented the entire industry as mentioned in the first sentence of this thesis focused on the competitive advantages of streamlined portfolio and software focus. Firstly, his opinion of the limited portfolio of Tesla that “We (Mercedes) are required by the market to have that many models, Tesla must be leaving market share on the table with these few models” holds substantial relevance. In his opinion, the ideal situation for a car manufacturer is one like Mercedes which covers every single model category. He stated that “from compact A-class to over the S-class to Semitrucks, Mercedes can deliver literally anything”. Consequently, his perspective was that Tesla had to expand to other categories at some point but he stated to be unsure about when and how a project like the Tesla cybertruck or Tesla Semi will be commercialized. While he described their portfolio as too small, he also admitted that despite these limitations they are achieving impressive market shares around Europe. On the topic of software focus, the interviewee stated that like VW, Mercedes is trying to vertically integrate more parts of the software development. But he also stated that it is very hard to find employees that are qualified enough to work on these aspects. He stated the opinion that Tesla with its innovative appeal would probably have a lower problem with attracting such Talents. Thus, the interviewee also coincided with the stated opinion that Tesla’s competitive advantage in software development would be really hard to be copied by Mercedes. Nonetheless, he stated that software development currently does not pose a challenge to Mercedes that is in any way comparable to the supply chain crisis. In his opinion, chips and semiconductors are the main bottlenecks of any German manufacturer and he described to be impressed by Tesla being able to solve that issue by redeveloping software to account for different chip models.