THE SHIFT TOWARD ELECTRIFICATION IN THE AUTOMOTIVE INDUSTRY

A Scenario Analysis Investigating What Sourcing Mode for Lithium-Ion Battery Cells Original Equipment Manufacturers Can Take to Meet Future Demand in The United States

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ABSTRACT

The automotive industry is one of the main contributors to greenhouse gas emissions and has consequently commenced its transition toward producing more sustainable vehicles. Electric vehicles are contributing to sustainable development and due to new components, original equipment manufacturers are facing substantial supply chain challenges. The most critical component of an electric vehicle is the lithium-ion battery cell, and because of deficits in the supply of lithium-ion battery cells, original equipment manufacturers are facing challenges in sourcing to meet future demand. This topic is interesting to investigate within the American market where a new free trade agreement puts pressure on original equipment manufacturers to localize the supply chain. This, in combination with low demand for lithium-ion battery cells in the United States, forces original equipment manufacturers, in particular, to rethink their sourcing mode of lithium-ion battery cells in the United States.

From the perspective of an original equipment manufacturer present in the United States, this research investigates possible future outcomes of the shift toward electrification in the automotive industry. The purpose is to investigate what sourcing mode for lithium-ion battery cells original equipment manufacturers can take today in order to adapt to future changes and meet demand for electric vehicles. By using a customized scenario planning framework, the research enables investigating the uncertain and dynamic environment of the automotive industry. With a time-frame of ten years, the outcome is four plausible future scenarios generated through qualitative interviews within three areas of investigation: politics and trade, market development, and technology. The most critical uncertainties that will shape the future development of electric vehicles and lithium-ion battery cell manufacturing in the United States are bundled along two dimensions. These are the level of Environmental Engagement in the country and the Balance of Power between original equipment manufacturers and cell manufacturers. By combining these two dimensions in a matrix, four plausible future scenarios are shaped, namely: Make America Green Again, I Have A Green Dream, Climate Change, Who?, and Electrification Awaits.

Based upon these four scenarios, a core strategy is formulated adaptable regardless of how the future emerges. This allows original equipment manufacturers to adopt the most beneficial sourcing mode to strategically prepare for the future. The research concludes that original equipment manufacturers should engage in cell manufacturing through close relationships and collaborations with cell manufacturers, hence, have a relational view on sourcing. This allows for co-developing lithium-ion battery cells to fit the vehicles and also incentivize the cell manufacturers to innovate and enhance performance. This strategy enables the possibility for original equipment manufacturers to easily integrate cell manufacturing in-house and undertaking production themselves, or take a step back and allow the close relationships function as a strong supplier base, depending on how the future emerges.

Keywords: Automotive Industry, Electrification, Electrification in the United States, Lithium-ion Battery Cells, Scenario Planning, Sourcing, Sourcing Continuum, Transaction Cost Theory.

READER'S GUIDE

This research takes the perspective of an original equipment manufacturer in the automotive industry present in the United States, facing challenges in the shift toward electrification. Through a qualitative research strategy, the gathered data takes multiple perspectives into account offering a thorough presentation of relevant factors to consider. Therefore, for original equipment manufacturers in this position, *Section 4.* is of interest as it presents the factors important to consider for future competitiveness.

This research is relevant not only for original equipment manufacturers in the United States but for all firms interested in the electrification of the automotive industry, particularly in the American market. For insights in the future of the automotive industry in the United States., start with the thorough introduction in the first section to get an overview of the ongoing shift. Thereafter, jump to *Section 5.4.* where four plausible future scenarios of the automotive industry are described. Moreover, *Section 5.5.* and *Section 6.* outline the results and provide recommendations with strategic actions for original equipment manufacturers to stay competitive in the future.

For those wanting a more practical knowledge about how to decide on sourcing mode as well as how to use scenario planning in practice, the literature review in *Section 2.,* as well as the methodology in *Section 3.,* provides a clear description for how to use these theories in a new context. Furthermore, *Section 5.* presents the utilization of the customized scenario planning framework including an element from sourcing theories in the context of this research. Additionally, *Section 6.3.* presents the academic implications of using a practical tool in this context and highlights the learnings from the customized framework.

ABBREVIATIONS AND DEFINITIONS

CV – Commercial vehicle, i.e. a vehicle used in commercial activities. E.g. buses, trucks, and forklifts.

Development factor – A factor mentioned by the respondents identified through a thematic analysis. These constitute a foundation for identifying trends and uncertainties in scenario planning.

EV – Electric vehicle, i.e. a vehicle completely powered by and charged through electricity (By others also referred to as BEV – Battery Electric Vehicle).

ICE – Internal combustion engine, i.e. the engine used in traditional fossil fuel-based vehicles.

ICEV – Internal-combustion engine vehicle, i.e. a traditional fossil fuel-based vehicle.

LIB – Lithium-ion battery.

NAFTA – North American Free Trade Agreement. A free trade agreement between the United States, Mexico, and Canada.

OEM – Original equipment manufacturer.

Powertrain – A technical system of components generating power and delivers it to the road surface, i.e. the propulsion motion moving a vehicle forward.

ROW – Rest of the world.

RVC – Regional value content, i.e. a percentage indicating the minimum value of a good that must be produced in a local region.

Scenario Planning – A method for strategic foresight used to map out plausible scenarios of the future and define strategic actions accordingly.

Trend – A development factor with a certain outcome, meaning it has a certain influence on future scenarios.

Uncertainty – An development factor with an uncertain outcome, meaning that the influence on future scenarios is uncertain.

USMCA – United States-Mexico-Canada agreement. A free trade agreement between the aforementioned countries with pending ratification, thus not yet in effect. It is a result of renegotiations of NAFTA and will thus replace the current agreement.

Vertical integration – A business integrating part of the supply chain in their own possession to control the supply.

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1. INTRODUCTION

The introductory section serves to present the background of the automotive industry's shift toward electrification and the issues arising with the deficit of lithium-ion battery cells. The problem discussion outlines the constraints and the development for electric vehicles imposing challenges for original equipment manufacturers to source lithium-ion battery cells in the United States. Thereafter, the purpose and the research questions are presented. Lastly, the contribution and context, delimitations as well as the disposition of the research are outlined.

1.1. BACKGROUND

The automotive industry has, until recently, been considered mature and stable and original equipment manufacturers (OEMs) have had a steady position with few threats from new entrants (Ferràs-Hernández, Tarrats-Pons & Arimany-Serrat, 2017). However, in recent years, the industry has been facing a paradigm shift where new technologies are transforming the industry (Ferràs-Hernández et al., 2017; Rodrigues Vaz, 2017).

The automotive industry is one of the largest industries globally and it is also one of the main contributors to climate change (Günther, Kannegiesser & Autenrieb, 2015; Kannegiesser, Günther & Gylfason, 2014; Tan, Mu, Wang, Zhuang, Cheng, Wang & Gu, 2011). The main reason is that the vehicles are based on fossil fuel with internal-combustion engines (ICE) generating a vast amount of greenhouse gas emissions (Günther et al., 2015; Rodrigues Vaz, 2017). Developing new solutions and technologies reducing greenhouse gas emissions is critical. Due to this, the automotive industry has commenced the transition toward the manufacturing of more sustainable vehicles (Kannegiesser et al., 2014; Rodrigues Vaz, 2017).

Electric vehicles (henceforth EVs) are described as the key technology contributing to the sustainable development (Cárdenas & Garvey, 2018; Günther et al., 2015). One of the most critical components in an EV is the battery, as it is crucial for the performance and driving range of the vehicle (Han, Ouyang, Lu & Li, 2014). The battery in an EV corresponds to the fuel in an ICE vehicle (ICEV) and is a part of the powertrain of the vehicle (Günther et al., 2015). Furthermore, the battery is the major cost driver of an EV and estimated to make up between 35% and 50% of the total cost of the EVs (Eddy, Pfeiffer & Van de Staaij, 2019; Günther et al., 2015; Hagman, Ritzen, Stier & Susilo, 2016; Küpper, Kuhlmann, Wolf, Pieper, Xu & Ahmad, 2018; PWC, 2019; Safari, 2018).

The batteries most often used in EVs are lithium-ion batteries (henceforth LIB). A LIB essentially consists of three components, namely battery cells, modules, and packs. The cell is the smallest part of the LIB but is also viewed the most important one (Coffin & Horowitz, 2018). It is the primary component, and, to a large extent, it determines the cost of the battery as it is the most cost-intensive component (Küpper et al., 2018; Pistoia, 2014). As the LIB, and consequently the LIB cell, is the most important component of an EV and the major cost driver, the future manufacturing of EVs rely heavily on the manufacturing of LIB cells. Hence, the future development of the LIB cell market is of great significance for OEMs.

The transition toward manufacturing of EVs requires new components for the powertrain which has a great effect on the supply chain of OEMs (Kannegiesser et al., 2014). Traditionally, the automotive industry includes a high level of outsourcing with OEMs possessing a high degree of bargaining power within the established supply chain. Outsourcing in the industry accelerated in the 1980s which not only lead to outsourcing of parts and components but also suppliers beginning to participate in product design (Bilbao-Ubillos, 2010). Choosing and maintaining the supplier base has been an important strategic issue for OEMs (Schmitt, 2013). The supplier base in the automotive industry is characterized by high competitiveness with suppliers offering differentiation of both products and services (Schmitt, 2013). However, since the industry requires backward integration, specific components require close collaboration with suppliers or for OEMs to undertake production in-house (Monteverde & Teece, 1982). Moreover, proximity between manufacturing facilities plays a crucial role (Schmitt, 2013). The presence of OEMs in a geographical location tend to naturally attract investments by automotive suppliers (Salihoglu & Salihoglu, 2016).

For EVs, the supply chain looks rather different than for ICEVs. As visualized in *Figure 1.1.*, the supply chain of the LIB for an EV involves five key steps. A significant difference is that LIBs are manufactured by firms outside the traditional supply chain of the automotive industry (PWC, 2019). Advanced technologies result in external suppliers playing an increasingly important role in engineering and design (Schmitt, 2013). This, in combination with the LIB cell generating substantial value to an EV, makes the cell manufacturer even more important in the supply chain of an EV. The manufacturing of LIB cells is today concentrated in Asia and dominated by China, Japan, and South Korea (Eddy et al., 2019.) The rest of the world relies on importing LIB cells from these countries. This results in a lack of bargaining power for OEMs, lack of proximity, and a less competitive supplier base resulting in OEMs facing a risk of failing to secure future supply of LIB cells to meet the demand for EVs (Eddy et al., 2019).

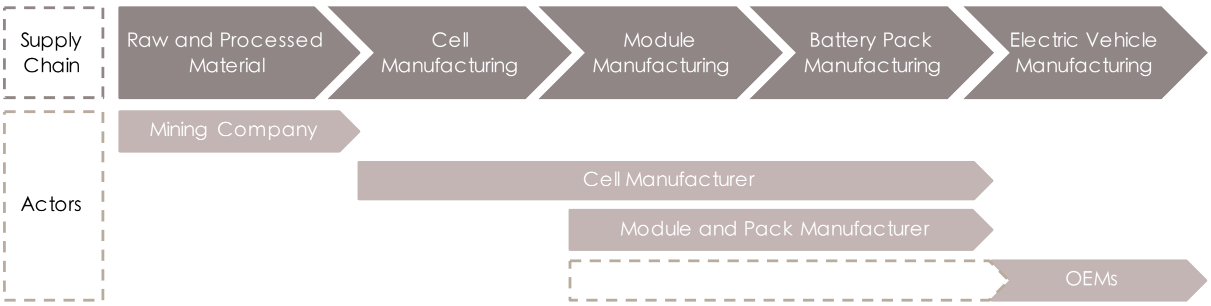

Figure 1.1. Supply Chain of LIB Cell Manufacturing and Actors Involved.

The supply chain of a LIB is complex due to the dependency of raw material such as lithium and cobalt which aggravates the cell manufacturing process as supply is limited to certain geographies. The manufacturing of the three parts of the LIB is often separated globally (Coffin & Horowitz, 2018). The module and pack assemblies are often located close to vehicle manufacturing, sometimes in the ownership of OEMs due to these parts being large and heavy, causing transporting and logistic costs to be high (Coffin & Horowitz, 2018). As stated earlier, proximity in the automotive industry is a crucial part. Not having the production of cells in close proximity increases the supply chain risks for OEMs since there is a deficit in the supply of the cells (Eddy et al., 2019).

As the demand for EVs grows, OEMs need to suitably source LIB cells and reduce the supply chain risks (Eddy et al., 2019). The rest of the world (ROW) needs to catch up with LIB cell manufacturing to avoid dependency on certain countries (Sheyder, 2019). However, further issues drive the complexity of cell manufacturing. Firstly, it requires high investment costs and a simultaneous scale-up of demand and supply to reach economies of scale and profitability (Lowe, Tokuoka, Trigg & Gereffi, 2010).

Secondly, an efficient infrastructure and an overall sufficient ecosystem is necessary, why cell manufacturers continuously build facilities in Asia as the proper infrastructure and ecosystem already has been established there (Lowe et al., 2010). Traditionally, OEMs themselves have been the drivers of the development in the automotive industry since engineering excellence generated competitiveness and differentiation (Ferràs-Hernández et al., 2017). As the automotive industry faces a paradigm shift, OEMs need to prepare and adapt to the shift toward the electrification of vehicles. Cell manufacturers are becoming increasingly important in the supply chain of EVs and since they hold the strongest bargaining power, the competitiveness of OEMs is put at risk.

1.2. PROBLEM DISCUSSION

Several countries around the world have initiated the shift toward EVs. Because of the increase in demand for EVs, countries and industries have also realized the importance of initiating domestic cell manufacturing. Even though investment costs are high, forecasts show that the global capacity of LIB cell manufacturing will grow robustly (Benchmark Mineral Intelligence, 2019; European Battery Alliance, 2020a). However, one country is discussed to initiate cell manufacturing at a slower pace, namely the United States (the U.S.). Their market share of the global LIB supply is contrarily forecasted to decline (Rapier, 2019). One reason for this could be that the U.S. is slower at adapting to the electrification of vehicles in comparison to the rest of the world (CB Insights, 2020; PWC, 2019; Rapier, 2019).

The U.S. has traditionally been one of the largest vehicle manufacturers globally (Ferràs-Hernández et al., 2017). Even though the shift toward EVs was commenced in the U.S., it is estimated that Europe and China will lead the way in the adoption of EVs (Ferràs-Hernández et al., 2017; PWC, 2019). Despite the global shift toward electrification, the U.S. market remains focused on ICEVs. Nonetheless, it is increasingly important for OEMs to prepare for this shift regardless of where they are based and secure the supply chain of components for EVs (PWC, 2019). This can be especially difficult in the U.S. due to the slow adoption of EVs (PWC, 2019).

The speed of the adoption of EVs in a country is described to be determined by factors at three different levels: political, market, and technology (Gao, Kaas, Mohr & Wee, 2016). Firstly, in terms of politics, the adoption varies greatly in different regions depending on regulatory push in terms of emission regulations and financial incentives for EVs. Subsidies offered by governments are described to increase market diffusion by reducing the price premium of the vehicle (Safari, 2018). Secondly, the consumer pull determines the demand at a market level (Gao et al., 2016). This is affected by the attributes of the vehicle such as driving ranges and cost (Safari, 2018). Thirdly, the technology of LIB cells plays an important part and improvements in the technology positively impact the market diffusion, making the concerns on political and market level less important (Gao et al., 2016).

Even if it is widely known that ICEVs are one of the biggest sources of CO_2 emissions globally, the current federal administration in the U.S. has decided to withdraw regulations on CO_2 emissions and lower the costs of fuel (Milman, 2018; Statista, 2020a). This naturally affect the domestic demand for EVs. However, alongside a slow adoption of EVs in the U.S., the automotive industry is facing increased pressures on localizing the supply chain in the U.S (Alanis et al., 2018). This, due to a new free trade agreement in North America, USMCA. USMCA will replace the NAFTA agreement and implies new regulations for trade between Canada, Mexico, and the U.S. (Alanis et al., 2018). The main effect of USMCA is an increased requirement on regional value content (RVC). This means that 70-

75% (depending on type of vehicle) of the total value of a vehicle needs to be sourced from North America if traded in the region, otherwise this means that OEMs need to pay tariffs on the imported components (Alanis et al., 2018). Because OEMs often import components from outside North America, they are required to adjust their supply chains to fit the new regulation. This is in turn unfavorable for the adoption of EVs, as the U.S. market is characterized by low demand resulting in domestic LIB cell manufacturing having a slow growth rate. Further, USMCA implies particularly high effects on manufacturing of EVs since the supply of the LIB cell, the major cost driver, is limited and generally sourced from Asia.

The difficulties of sourcing due to USMCA, in combination with the slow adoption of EVs in the U.S., create ambiguous forces for OEMs. USMCA is incentivizing domestic manufacturing of LIB cells whilst the slow shift toward electrification limits a profitable scale-up for cell manufacturing. These two contradictory forces impose OEMs to review the sourcing strategies to identify the best possible way to secure LIB cells and remain competitive in the U.S. in the future. OEMs need to strategically prepare for these challenges, however, as of today, a high level of uncertainties makes the future outcome hard to predict. As explained above, three areas are of particular importance for how the market for EVs will develop, politics, market, and technology. Due to USMCA, trade is also considered of particular importance. Consequently, the three areas politics and trade, market development, and technology, have a direct effect on the evolution of LIB cell manufacturing. It is, therefore, essential to identify how these three areas will develop in order to map out the future possible outcomes to allow OEMs to take strategic actions regarding how to sustain competitiveness in the future.

1.3. PURPOSE

This research aims to, from the perspective of an OEM in the automotive industry present in the U.S. market, investigate possible future outcomes of the shift toward electrification in the automotive industry in the U.S. More specifically, the supply chain risks for LIB cells implies an investigation to identify the most suitable sourcing mode. Predicting the future is difficult, especially when investigating a dynamic and uncertain world. However, scenario planning is considered an efficient tool for strategic planning in uncertain conditions and when industries face significant changes (Lindgren & Bandhold, 2003; Ringland, 1997; Schoemaker, 1995). By including stakeholders from three areas of investigation (politics and trade, market development, and technology) trends and uncertainties are identified to create plausible scenarios of the future. Each scenario aims to provide different views on how the market for EVs can develop in the U.S., what role OEMs can have, and how their involvement in the supply chain of LIB cells can look like. The purpose is to investigate what sourcing mode for LIB cells OEMs can take today in order to adapt to future changes and meet demand for EVs. Taking a future perspective of ten years, the research provides recommendations for OEMs in how to source the LIB cells depending on how the future emerges. By mapping out the future possible outcomes, OEMs facing the issues discussed will receive guidance in their strategic planning.

1.4. RESEARCH QUESTIONS

To fulfill the purpose and provide recommendations for OEMs on how to manage the uncertainties of the shift toward electrification in the U.S., the following research question has been formulated.

What sourcing mode for lithium-ion battery cells can original equipment manufacturers take to meet future demand in the United States?

Furthermore, to answer this question, two sub-questions have been developed. The scenario planning process enables answering these questions which in turn provides a thorough contexture to answer the main question.

- What trends and uncertainties affect the future supply of lithium-ion battery cells?
- What are the future scenarios for the market of electric vehicles in the United States?

1.5. CONTRIBUTION AND CONTEXT

The researchers aim to contribute to both industry and academia. Firstly, not only will the research provide recommendations for OEMs in how to source LIB cells to meet market demand in the U.S., it will also take a theoretical viewpoint of established frameworks. By integrating the established frameworks and putting them in the specific context of this research, the contribution to academia is enhanced. Secondly, the industry achieves insights and knowledge regarding what factors affect the future market for LIB cells, and how these can be considered and used to reduce the uncertainties and risks for OEMs. Moreover, strategic actions supported by established frameworks enables accurate strategic planning for OEMs.

This research was initiated in collaboration with Volvo Group, hereinafter 'the partner company'. The partner company maintains a strong global position, including presence in the U.S. The partner company worked as a case in practice in this research, providing a connection to the industry. The purpose of the research was discussed in close collaboration and resulted in deep anchoring of the problem discussion. Furthermore, the partner company guided the focus of the research, thus influenced the market of choice as well as the three areas of investigation. Through initial conversations about the sourcing of LIB cells, the partner company expressed the greatest challenges to be located in the U.S. The perceived challenges were connected to uncertainties within politics and trade, market development, and technology. The partner company asked for an overview of macroeconomic factors affecting the industry, why the context of this research takes an external perspective identifying factors outside of OEMs.

The partner company is producing commercial vehicles (CVs). It is, however, important to highlight that the research takes the perspective of an OEM within the automotive industry present in the U.S., independent of production of CVs or passenger vehicles. This, because LIB cells are used in all of these applications and thus the scope of the research applies for all OEMs present in the U.S.

1.6. DELIMITATIONS

As briefly outlined in the purpose, the research contains several limitations. The main reason for this is to ensure a clear focus on the research and enable relevant findings to be identified within the time constraints. Nonetheless, the limitations are important to consider as they affect how the research should be perceived and how the findings can be interpreted.

Firstly, the research focuses on investigating the American market, leaving all other markets outside of the scope. The U.S. is relevant to investigate because the market is one key market in the automotive industry with many OEMs present today. Meanwhile, the market's future demand for EVs is uncertain and it is highly unexposed to LIB cell manufacturing. The U.S. is also stated to lag behind in the electrification of vehicles whilst OEMs are facing pressures from a new trade agreement. As there are many uncertainties, mapping out the potential outcomes of the market in the U.S. is of interest.

One important note is that the research takes the perspective of an external analysis. Therefore, microeconomic factors within OEMs, such as internal capabilities and current strategies, are excluded. The research provides an overview of possible future outcomes, thus, the result is independent of firm-specific resources. The outcome will provide recommendations and guidance for strategic actions, however, not include the actual implementations of strategic actions.

Moreover, the application of interest in this research is pure EVs, hence there will not be a great discussion on hybrids or plug-in hybrids. This delimitation was determined in collaboration with the partner company since the development of the EV market is more uncertain and involves greater strategic actions.

The research only includes the manufacturing of LIB cells, and not the manufacturing of other parts of the LIB nor the entire LIB itself. As illustrated and explained in the background, the manufacturing of modules and packs is already integrated in the business of some OEMs and many already have plans on how to secure manufacturing of these parts in the future. Whereby, excluding these parts was found favorable. Also, the LIB cell is considered a key component as it is the main cost driver and the manufacturing of the LIB cell is more complex than the other parts.

Lastly, when investigating the LIB cell, it could be of interest to consider the various types of cells and the many variations of possible chemistries. For instance, there are three common types of LIB cells (cylindrical, prismatic, and pouch) that constitute different performances. However, all cells are used in EVs today due to choice of power, energy density, weight, design, etc. Furthermore, the type(s) of cell preferred in the future is unknown. Therefore, the research will not distinguish between types of cells, rather LIB cells in general will be discussed.

1.7. DISPOSITION

As outlined in the purpose of the research, scenario planning is perceived an appropriate framework for investigating the future development of the EV market and LIB cell manufacturing in the U.S. As shown in *Figure 1.2.*, the scenario planning process is conducted throughout this research, why certain sections differ from an academic disposition. *Figure 1.2.* illustrates the relationships between the sections, and how the scenario planning process is carried out.

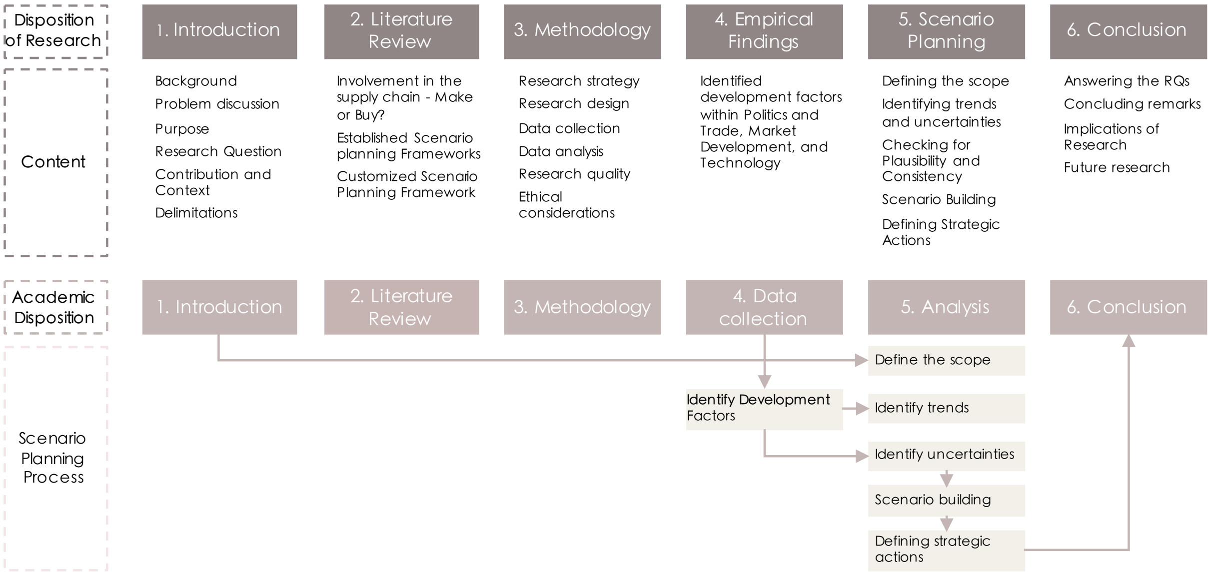

Figure 1.2. Disposition of Research.

2. LITERATURE REVIEW

This section presents existing literature within the fields of sourcing models and scenario planning to provide a theoretical background. Initially, a background of the transaction cost theory will be presented, followed by the relational view and the sourcing continuum. Thereafter, a background and explanation of scenario planning will be outlined, followed by two established step-by-step frameworks. Lastly, a customized framework developed by the researchers is presented suitable for the purpose and scope of this research. The customized framework integrates the theories of sourcing models into scenario planning, where the sourcing models works as a theoretical lens whereas scenario planning is used to provide a practical framework.

2.1. INVOLVEMENT IN THE SUPPLY CHAIN - MAKE OR BUY?

As OEMs in the automotive industry are facing issues on how to source LIB cells in the future, questions on how to determine the suitable sourcing mode arise. It exists various theories on sourcing models and there are different ways to determine the most suitable one. The transaction cost theory is described as the original view on sourcing and has influenced subsequent research, why it is important to present. It also provides an overview on sourcing as a phenomenon. Moreover, additional theories with a more modern viewpoint are presented as they relate to dynamic and uncertain environments and how to determine the level of involvement in the supply chain. These are highly applicable for this research as the uncertain future builds the foundation for this research.

2.1.1. Introduction to Transaction Cost Theory

An entrepreneur wishing to initiate production has the choice of contracting others to undertake production or undertaking production themselves within the firm (Jones, 2004). Transaction cost theory aims to answer this question of ‘make or buy?’. The research on transaction costs was initiated by Ronald Coase in 1937 in his article ‘The Nature of the Firm’ (Geyskens, Steenkamp & Kumar, 2006). He viewed the market and the firm as two contrasting forms to coordinate production (Williamson, 2010). Proposed by Coase, the question of ‘make or buy?’ is not a given choice. Today, many researchers have built upon Coase’s idea and the most prominent researcher is Oliver E. Williamson who received the Nobel prize for his work in 2009.

The central question of transaction cost theory is whether a transaction is more efficiently made within a firm (i.e. vertical integration) or by outsourcing it to the market (i.e. buying) (Williamson, 2010). Historically, vertical integration was understood as a way to acquire market power, something Williamson challenged and proved not necessarily to be the case (Dahlstrom & Nygaard, 2010). Instead, Williamson describes how firms are different from markets and the advantages and disadvantages of both (Dahlstrom & Nygaard, 2010). The transaction cost theory is of value for managers’ economic understanding on how to shape the boundaries of a firm. Firms that apply inappropriate boundaries are described to more likely be less profitable and less likely to survive (Dahlstrom & Nygaard, 2010).

Transaction cost theory view markets and firms as two alternative ways to manage production (Jones, 2004). Thus, a firm has a choice of relying on the market and buy the product or acquiring the control and make it themselves. The market is characterized by high-powered incentives, little administrative control, and a contractual arrangement (Williamson, 2008). This mode is suitable for an autonomous way of working but not for cooperation. The advantage of using the market lies in simplicity as it enables a firm to compare transaction prices (Vitasek, 2016). However, more complex products or services often result in increased transaction costs in the market (Vitasek, 2016). The firm, on the other hand is reverse, meaning it has low-powered incentives and meaningful administrative control (Williamson, 2008). The firm, or vertical integration, is characterized by ownership and control of several stages in the supply chain of a product and involves backward and/or forward integration (Grant, 2016).

To determine the most suitable mode, a firm compares the marginal cost of the transaction in the market with the marginal cost of the transaction within the firm (Jones, 2004). As the goal is for the firm to minimize transaction costs, the mode reflecting the lowest transaction cost is the one the firm should choose. Consequently, it might be advantageous to source certain activities from the market whilst keeping the manufacturing of other activities within the firm (Jones, 2004). Moreover, certain factors lead to firms adopting different attitudes toward different modes and thus it essential to evaluate each specific situation (Jones, 2004).

The transaction costs of undertaking production internally involve administrative costs (Grant, 2016). The transaction costs of markets include costs for search, negotiation, drawing up contracts, and monitoring the contracts (Grant, 2016). Moreover, uncertainty and complexity increase the cost of writing complete and enforceable contracts (Dahlstrom & Nygaard, 2010). Because transaction costs increase alongside researching the market for potential suppliers and market prices, signing long-term contracts is an efficient way of reducing costs (Jones, 2004). However, the disadvantage of long-term agreements is changes in market conditions and advancements in technology, resulting in reduced competitive advantage for the buyer (Jones, 2004).

2.1.2. Factors affecting the choice of 'Make or Buy?'

Research within transaction cost theory investigates what factors that determine the choice of 'make or buy?' (Williamson, 2010). Apart from rationality, risk propensity, and other subjective aspects, the trade-off depends on various factors specific to each situation (Vitasek, 2016). Williamson (1973) explains these additional factors to have a high impact and thus supposedly be operative in the choice of transactional model in practice. Building upon the research from Williamson, Jones (2004) thoroughly explains the factors having a potential impact on the transaction cost, and the choice of 'make or buy?'. These seven different factors are described below and summarized in *Table 2.1*.

Economies of scale. Economies of scale implies the larger the number of outputs, the lower the average cost (Jones, 2004). In the presence of economies of scale, the market is the preferred option because of its potential to aggregate demand (Lyons, 1995). A firm is generally not willing to sell its in-house produced products to competitors, resulting in economies of scale being hard to accomplish. Economies of scale are especially important to consider when the products are technological (Lyons, 1995). What is important to bear in mind is that when asset specificity increases, there is a lower possibility for the market to reach economies of scale. Therefore, economies of scale are of great importance in the 'make or buy?' decision when there is absence of specific assets (Lyons, 1995).

Number of firms. The higher the number of firms competing for the customers in a market, the closer the prices are to the marginal and average cost of production (Jones, 2004). If there is a large number equally qualified to supply a good or a service, competition will be obtained (Williamson, 1973). This implies that the prices on the market will be lower when a large number of firms are competing, causing the market to be preferable (Jones, 2004). In the opposite scenario, where there are few firms competing, prices are set more monopolistically, and the buyers oftentimes benefit from producing it internally.

Management costs. Management costs depend on the coordination of transactions within a firm (Jones, 2004). They are increasing alongside requirements of greater incentives for employees to increase performance, difficulties of controlling opportunistic behavior with employees, and the increase in complexity in the organization. The ideal manager is described to discover and extinguish these types of behavior (Williamson, 1973).

Opportunism. It is assumed that all parties involved in a contract behave honestly and aim to fulfill its part (Jones, 2004). Because of bounded rationality and incomplete information, opportunities to behave opportunistically arise (Jones, 2004). The most common form of opportunism is for one party to strategically disclose asymmetric information to its advantage (Williamson, 1973). Opportunism is a self-centered behavior with lack of honesty from one party in the agreement (Jones, 2004). This behavior is common when there is few suppliers, high switching costs, and difficult to measure quality. When one party is able to take advantage from differences in information, opportunistic behavior can occur. Potential for opportunistic behavior causes firms to undertake production in-house instead of relying on the market.

Asset specificity. Asset specificity is defined by resources committed to a specific activity that cannot be used for other activities without losing significant value (Jones, 2004). There are three types of specific assets. (1) Site-specific assets designed for a specific piece of land, for instance, production facilities located in close proximity, so transportation and coordination costs are reduced (Dyer & Singh, 1998; Jones, 2004). (2) Physical-specific assets or customer-specific assets involving tailored machines or processes developed to fit a particular contract (Dyer & Singh, 1998; Jones, 2004). Lastly, (3) human asset specificity, when a person is trained for a specific process that cannot easily be transferred (Jones, 2004). This often means that know-how is accumulated through long lasting relationships (Dyer & Singh, 1998). Specific investments create lock-in effects where buyers have high switching costs and there is an increased risk of opportunistic behavior (Vitasek, 2016; Ebers & Semrau, 2015). Consequently, the higher the level of asset specificity, the more common it is for a firm to produce the product or service in-house (Jones, 2004). Contrary, when the asset is not specific, the market is favored as it provides higher profitability and optimization of innovation in comparison to a single firm (Lyons, 1995).

Firm-specific knowledge. Possessing specialized knowledge internally related to production, technology, or the products and services of the firm enhances the importance of keeping the knowledge within the firm (Jones, 2004). It is closely related to competitive advantage meaning internal production is preferable.

Uncertainty about the future. Entering long-term contracts when there is uncertainty about the future would require complex contracts covering multiple contingencies (Jones, 2004). This implies that in an uncertain world, it is more beneficial to undertake production within the firm. Also, uncertain conditions imply higher risks of opportunism, further favoring in-house production (Williamson, 1973). However, it can vary depending on type of uncertainty. One type is technological uncertainty, i.e. the inability to foresee technological development or changes in standards (Geyskens et al., 2006). This type of uncertainty favors the market as it provides flexibility for the buyer to change suppliers alongside potential changes in technological advancement, avoiding a lock-in position with an obsolete technology (Geyskens et al., 2006).

Factor	Market	Firm
Economies of scale		+
Large number of suppliers		+
Small number of suppliers	+	
Management costs		+
Opportunism	+	
Asset specificity	+	
Firm-specific knowledge	+	
Uncertainty	+	

Table 2.1. Summary of factors influencing the relative efficiency of 'make or buy?' (Jones, 2004).

As shown in *Table 2.1.*, the factors are influencing the choice of 'make or buy?' differently where '+' indicates the favored transactional model with the occurrence of a factor. Consequently, as stated earlier, the choice of 'make or buy?' is not a given choice but instead influenced by various factors making it necessary to assess each situation thoroughly.

2.1.3. Make or Buy through a Relational View

As stated, several factors affect the choice of 'make or buy?'. Thus, when evaluating the sourcing mode, it is essential for a firm to know its resources and capabilities. Buyers regularly use suppliers for areas within which they lack core competencies (Vitasek, 2016). This, because there are oftentimes many hidden transaction costs for firms producing non-core activities (Vitasek, 2016).

Prahalad and Hamel (1990) state that it is possible to acquire important and significant components and technologies from a supplier, however, it does not provide a long-term competitive advantage. Instead, it puts the firm in a vulnerable position of the supplier as changes can occur drastically. The resource-based view provides a theory on how firms retain competitive advantage (Dyer & Singh, 1998). Instead of valuing the attractiveness of an industry, this view focuses on the heterogeneity of a specific firm and its capabilities, resources, and assets (Dyer & Singh, 1998). The competitiveness of a firm varies short-term and long-term. In the short-term, price levels and performance of a product or service affects the competitiveness (Prahalad & Hamel, 1990). In the long-term, however, competitiveness derives from core competencies that enable a firm to produce new, innovative products (Prahalad & Hamel, 1990). To secure a foundation for long-term strategy, internal resources and capabilities are described to be more effective and important than external markets (Grant, 2016). The critical input is knowledge embodied in both human capital and machines, and key resource can thus be in both explicit and implicit form (Jones, 2004).

Prahalad and Hamel (1990) describe it to be possible to only focus on a few numbers of core competencies, making it important to outsource other areas. When firms outsource areas outside their core competence, they also wish for suppliers to drive innovation and enhance improvement in those areas, however, this is seldom the case (Vitasek, 2016). Both buyers and suppliers want innovation, but neither one is willing to make the investment. Vitasek (2016) indicates that to obtain a long-term value proposition it is no longer possible to possess the win-at-all-times mentality when it comes to sourcing and relationships with suppliers. Increasingly important is instead the power of collaborative sourcing and to drive innovation collaboratively with suppliers (Vitasek, 2016).

Important to realize is that the resources a firm uses might be internally within the firm or outside in other organizations (Gadde, Huemer & Håkansson, 2003). Based upon these arguments, Dyer and Singh (1998) provides another view on how firms can retain competitive advantages. In the relational view, one important area overlooked by earlier research is added, namely the outside boundaries of the firm. In the relational view, interfirm resources between several firms are explained to be of importance. It is described that productivity along the supply chain increases when the parties involve in relation-specific investments and combine their resources (Dyer & Singh, 1998). Moreover, it provides competitive advantages such as lower total costs along the supply chain, greater product differentiation, and shorter product development cycles (Dyer & Singh, 1998). Contrary to the resource-based view, a strategy from the relational viewpoint includes sharing and gaining valuable know-how with partners to access synergies. In contrast to the traditional view where a firm strengthens its bargaining power by increasing its number of suppliers, the relational view suggests that sharing knowledge with a small number of suppliers can increase a firm's profitability as it enhances the suppliers' incentives to improve performance.

Originally, transaction cost theory viewed the choice of 'make or buy?' dichotomously (Geyskens et al., 2006). However, as the business environment grows increasingly more global, uncertain, and volatile, this dichotomous approach is not sufficient (Vitasek, 2016). The question of 'make or buy?' is not that simple to answer, instead, sourcing should be viewed in a holistic and more strategic way (Vitasek, 2016). To enhance performance, it is essential for a firm to involve in industrial networks and build interdependencies linking its activities to other firms (Gadde et al., 2003). Relationships characterized by collaboration shifts the focus to equal winning and making it together with customers, suppliers, and other parties (Gadde et al., 2003). In fact, an industrial network can be seen as an inimitable resource in itself.

2.1.4. Sourcing as a Continuum

Building upon the relational view and the more modern view on business, a third alternative to the two traditional transactional models has emerged (Geyskens et al., 2006). The firm (i.e undertaking production in-house) and the market (i.e. outsourcing to the market) are placed on two polars, and in between, a hybrid mode is positioned implying a direct compromise between the two (Williamson, 2008). Vitasek (2016) further elaborates this by viewing sourcing modes along a continuum where different modes are positioned with gradual differences (Vitasek, 2016). Vitasek (2016) points out seven models to be placed along the continuum.

Basic Provider Model. This mode involves products and services with little differentiation. The standardization allows for a wide range of market options and usually the product has a set price. This mode is often used for buying standardized, low-cost products and services. The market is characterized by a large supplier base and low switching costs.

Approved Provider Model. In the second mode, products and services are bought from suppliers that meet certain criteria and are preapproved. In this mode, costs are competitive and as there exist numerous suppliers, the supplier needs to meet performance standards, otherwise there is a risk of being replaced.

Preferred Provider Model. In this mode, the buyer has chosen a supplier who can add important value to the business of the buyer and thereby allowing strategic goals to be met. Because the supplier contributes to the business of the buyer, creating a relationship is essential, explaining why this mode is relational.

Performance-Based Service Models. This mode is generally a long-term agreement combining the relational mode with an output-based mode. The supplier is not only chosen based on cost advantages but usually also on whether improvements are made. Incentives are generally used for meeting performance targets that otherwise can result in penalties. There is a high degree of integration between the supplier and the buyer, calling for a high level of collaboration.

Vested Sourcing Business Model. This mode is highly collaborative and includes value creation for both buyer and supplier. This means that both parties are equally committed to each other's success. The mode is most suitable for when a firm has innovative goals that cannot be achieved alone using traditional sourcing models. The goal is referred to as a desired outcome and can only be achieved through close collaboration between the buyer and the supplier.

Shared Services Model. This mode is suitable for firms struggling to meet complex business requirements with a supplier. It allows for internal development of required capabilities. The result is a centralized operation, oftentimes through an own organization, improving the efficiency of the firm whilst keeping the outsourcing at arm's length. The internal organization generally acts like an external supplier, charging their customers internally.

Equity Partnerships. The final mode constitutes of creating a legally binding entity. This can take many forms, for instance, an acquisition, a subsidiary, or a joint venture. An equity partnership is most suitable when internal capabilities are not adequate or sufficient and outsourcing is not a preferred option.

Interpretations from Vitasek's (2016) seven models along the sourcing continuum allows for a summarized sourcing model to evaluate the best sourcing mode. The summarized model takes both the traditional transaction cost theory as well as the relational view into account, providing a holistic approach on choice of sourcing mode. *Figure 2.1.* outlines the seven modes together with the three categories within which the modes are included, as well as the position of the traditional transactional models.

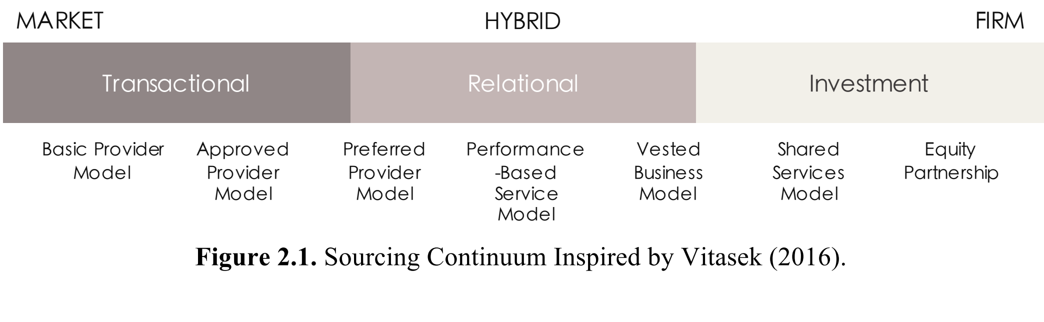

Figure 2.1. Sourcing Continuum Inspired by Vitasek (2016).

2.2. SCENARIO PLANNING

As earlier stated, scenario planning is an efficient tool for strategic planning in uncertain conditions (Lindgren & Bandhold, 2003). More specifically, the tool is beneficial for firms facing high uncertainties difficult to predict, or significant changes in the industry, as in the case of this research (Schoemaker, 1995). This section includes an introduction to scenario planning as well as two established scenario planning frameworks.

2.2.1. Introduction to Scenario Planning

Scenario planning was initially introduced to complement existing forecasting tools (Schwenker & Wulf, 2013). The goal of a scenario planning process is to gain a broad perception of the future in terms of trends and uncertainties (Schoemaker, 1995). Scenario planning is a disciplined method and it provides a thorough illustration of plausible futures (Lindgren & Bandhold, 2003; Schoemaker, 1995; Schwenker & Wulf, 2013). Moreover, it enables understanding the development systematically and identifying key factors and players influencing the industry (Lindgren & Bandhold, 2003). The key factors are referred to as development factors and these constitute the foundation upon which an identification of trends and uncertainties is made. Through the identification of trends and uncertainties, a series of scenarios can be conducted depending on the different possible outcomes (Schoemaker, 1995).

Scenario planning is a framework for strategic thinking, taking external changes and opportunities into account. It is closely related to strategic planning but as it integrates uncertainty into the process, it results in a strategic framework suitable for an uncertain world (Lindgren & Bandhold, 2003; Schwenker & Wulf, 2013). In contrast to other strategic planning tools, scenario planning elaborates on various uncertainties and the collective impact of them (Schoemaker, 1995). Hence, it allows for comprehensive planning and gaining a more holistic view of how the future might develop (Lindgren & Bandhold, 2003; Schwenker & Wulf, 2013). However, this also enhances complexity as the process does not result in one conclusion about the future making it more difficult to know what strategy to develop (Lindgren & Bandhold, 2003).

One important part of scenario planning is that it involves both internal and external stakeholders taking their respective perspectives into account (Schwenker & Wulf, 2013). Moreover, scenario planning is described to compensate for two mistakes typically occurring in strategic planning, namely underprediction and overprediction of change (Schoemaker, 1995). Also, it eliminates overconfidence and tunnel vision (Schoemaker, 1995). Specifically, scenario planning is beneficial because it can capture a wide range of possibilities in detail.

The developed scenarios are based on dichotomous uncertainties, i.e. 'either-or' uncertainties constituting of two possible outcomes which eliminates the feeling of being overwhelmed (Lindgren & Bandhold, 2003; Schoemaker, 1995). When uncertainties are discontinuous, i.e. consists of several possible outcomes, scenario planning is irrelevant since the possible outcomes are too many (Lindgren & Bandhold, 2003).

When conducting the scenario planning one common mistake is that the people involved tend to look at confirming evidence whilst disregarding opposing evidence (Schoemaker, 1995). This is important to bear in mind throughout the research to ensure reaching objective outcomes to the highest degree possible.

2.2.2. Established Scenario Planning Frameworks

Several established scenario planning frameworks exist, all of which share the common goal and purpose of identifying possible future scenarios. Scenario planning has been criticized due to the lack of proper descriptions of the process which requires the process to be time-consuming (Schwenker & Wulf, 2013). In this research, two acknowledged frameworks describing the process in great detail are presented. This research aims to use a scenario planning framework in practice, these two thoroughly defined frameworks are preferable as they clearly describe how to conduct the process. In addition, these frameworks are suitable for a modern business environment. Firstly, Schoemaker's (1995) systematic methodology aims to bridge the gap between theory and practice. Secondly, Schwenker and Wulf (2013) present a framework for scenario planning based on critique against previous methods being slow, time-consuming, and difficult to apply in practice.

Schoemaker's Ten-Step Process

Schoemaker's (1995) step-by-step description of the scenario planning process aims to describe how to strategically plan an organization's future by building scenarios.

Step 1. Define the Scope. The first step consists of defining the time-frame and scope of the analysis, this includes, for instance, market, geographic area, and product. This step depends on several factors such as product life cycle and political elections.

Step 2. Identify the Major Stakeholders. Determine who will have an interest in, be affected by, and influence the factors identified in the first step. This includes both internal and external stakeholders.

Step 3. Identify Basic Trends. Identify what trends will affect the issues identified in step one. This includes all external factors such as political, economic, and societal. Industry and firm-specific trends are also of interest. The author suggests using an influence diagram to explain how and why each trend affects the firm. The diagram consists of presenting if the impact is positive, negative, or uncertain. The identified trends need to be agreed upon by all identified stakeholders. If not, the trend should be included in the following step.

Step 4. Identify Key Uncertainties. The possible events that have an uncertain outcome but a significant impact on the firm are to be defined. As for the previous step, this step also includes all external events, e.g. political, economic, societal, and legal. For each uncertainty, the possible outcomes should be defined, preferably a small number of outcomes. Additionally, identifying relationships between the uncertainties might be of interest as some of them might relate to, and be affected by, one another.

Step 5. Construct Initial Scenario Themes. The trends and uncertainties make up the basis for constructing the scenarios. There are three common ways to do this. The first alternative includes putting each trend and uncertainty to positive values first, then negative values. A second alternative is to cluster the different outcomes around different scenarios such as high versus low continuity or degree of preparedness. Lastly, the third alternative is to select the two most important uncertainties and cross them.

Step 6. Check for Consistency and Plausibility. The now identified scenarios most likely have internal inconsistencies which are needed to consider. There is a three-way step to test the internal consistency. Firstly, the trends need to be compatible with the identified time-frame. If not, they are to be disregarded. Secondly, the scenarios should combine outcomes that are possible to occur alongside each other. Thirdly, the scenarios should not involve placing major stakeholders in positions they do not like and cannot change.

Step 7. Develop Learning Scenarios. In the seventh step, general themes should emerge. The objective is to identify themes of strategic relevance and thereafter organize the possible outcomes and trends around them. Hence, trends can be given more or less weight in different scenarios. The author stresses the name of the scenario to be of importance as each scenario is a story and should have efficient storytelling, starting with the name. The identified learning scenarios are tools for necessary research and further study. The scenarios are to be tested and developed before possible to use for decision making.

Step 8. Identify Research Needs. As stated in the previous step, further research might be necessary to gain a deeper understanding of the trends and uncertainties. A full understanding should be established which often require further research due to the firm's lack of knowledge in other industries and areas.

Step 9. Develop Quantitative Models. The internal consistencies are to be examined again after conducting additional research. A quantitative model could be used to ensure plausible scenarios.

Step 10. Evolve toward Decision Scenarios. The author describes the scenario planning process as iterative and advices reviewing steps one through eight to ensure the learning scenarios address the proper issues. There are certain criteria to determine if the final scenarios are efficient, such as relevance of the scenarios, internal consistency, and if the scenarios are representative. Additionally, the scenarios should describe a state of equilibrium, i.e. exist for some length of time.

Schwenker's and Wulf's Six-Step Process

Schwenker and Wulf (2013) provides a framework allowing for shorter planning periods with time-frames shorter than five years. It consists of six steps. These six steps are described as common features of traditional scenario planning frameworks.

Step 1. **Definition of Scope**. The first step is to define the scope of the project. This involves defining the goal, time-frame, stakeholders, and participants involved in the process. Schwenker and Wulf (2013) have developed a framework called 'the framing checklist' which enables ensuring specific aspects to be covered. This includes defining the focus of the scenario planning and the research question.

Step 2. **Perception Analysis**. This step consists of analyzing the perception of internal and external stakeholders on the development of the industry. It is especially interesting for internal stakeholders to recognize the opinions and expectations of external stakeholders, as this can challenge their view on the process. Hence, a widened view of possible futures is gained. The authors propose a framework called '360° stakeholder feedback', a two-part survey toward internal and external stakeholders. This step results in a list of development factors potentially impacting the future of the specific industry.

Step 3. Trend and Uncertainty Analysis. The third step is a joint combination of Schoemaker's (1995) third and fourth steps in the process. It structures and prioritizes the development factors identified in the previous step, hence identifying the key factors affecting the future. These factors determine the basis for the two scenario dimensions used in the scenario building. The authors use a framework called the 'impact/uncertainty grid'. In the grid, the trends and uncertainties are positioned systematically based on their impact on the firm and their degree of uncertainty.

Step 4. **Scenario Building**. In this step, the different scenarios are built based on the previously identified uncertainties. The scenarios describe the possible future outcomes and by combining the uncertainties with other external factors, four consistent and plausible scenarios are generated. The authors provide a framework in this section as well, namely the 'scenario matrix'. The matrix uses two dimensions and two defined extreme values for them. The matrix consists of four quadrants reflecting four different scenarios based on the outcomes of each dimension. Each scenario is described in detail using the causes and effects of the trends and uncertainties leading to the scenario by using an 'influence diagram'.

Step 5. **Strategy Definition**. Here, various strategies and possibilities alongside each of the four scenarios are developed. Concrete action plans are to be determined, allowing for a robust strategy. After determining the strategies connected to each scenario, the common elements of the four strategies form a core strategy possible to implement whatever change occurs. This approach allows for strategists to act flexibly with the ability to allocate resources efficiently. The strategic elements not common to all scenarios are used in the development of scenario-specific strategies which consequently are used to complement the core strategy.

Step 6. **Monitoring**. Lastly, the final step is made after the strategy has been defined and involves implementing the strategy. The main goal of this step is to ensure that the firm knows when adjustments to the strategy are required. By identifying several indicators and monitoring them, the firm knows when there is a need for actions to be taken. In addition to this, the firm should be monitoring the environment and external factors so actions can be taken if necessary.

2.3. CONNECTING THE DOTS

The literature presented has provided a basic understanding for both different views on sourcing as well as frameworks for scenario planning. This is highly relevant as it outlines important theories and factors to consider in this research. Nonetheless, a customization of the presented frameworks has been made by the researchers to properly fit this research. The following section contains a customized scenario planning framework consisting of five steps. The customized framework is rooted in the established scenario planning frameworks but adapted to fit the research context accordingly. It enables identifying the trends and uncertainties shaping the future of electrification and LIB cell manufacturing in the automotive industry. Additionally, it includes the question of 'make or buy?', inspired by the relational view and the sourcing continuum. Integrating the theories on sourcing models into the customized scenario planning framework enables identifying how OEMs most preferably can source LIB cells depending on the future outcome. Moreover, the sourcing continuum is used to guide the strategic recommendations depending on the emerging scenarios.

2.3.1. Customized Scenario Planning Framework

Due to the specific context of this research, a customized framework was perceived appropriate. By combining the established scenario planning frameworks and selecting the parts most suitable for this research, a clear and thorough framework was created allowing for high quality (Schwenker & Wulf, 2013). The purpose and delimitations of this research make certain steps of established frameworks less relevant. As described by Schwenker and Wulf (2013), the established frameworks have several common features. Taking advantage of this, the customized framework has enabled an integration of several elements from the different frameworks, resulting in a thorough process adapted to this research.

Due to the context of this research, having one foot in academia and one in the industry, a customized framework is preferable as it allows for necessary alterations. One fundamental adjustment for this research is excluding the step of identifying development factors from the scenario planning framework. Instead, this is considered part of the empirical findings, thus, presented in *Section 4.* and identified through thematic analysis. Due to the focus on external analysis in this research another important note is that the final step of the customized framework does not contain implementation and monitoring of strategic actions. The scenario planning process ends with providing recommendations and strategic actions on a more general level due to the lack of firm-specific insights. Remaining alterations are demonstrated below.

To provide a reliable approach throughout the research, the five steps presented in *Figure 2.2.* are included in the customized scenario planning framework.

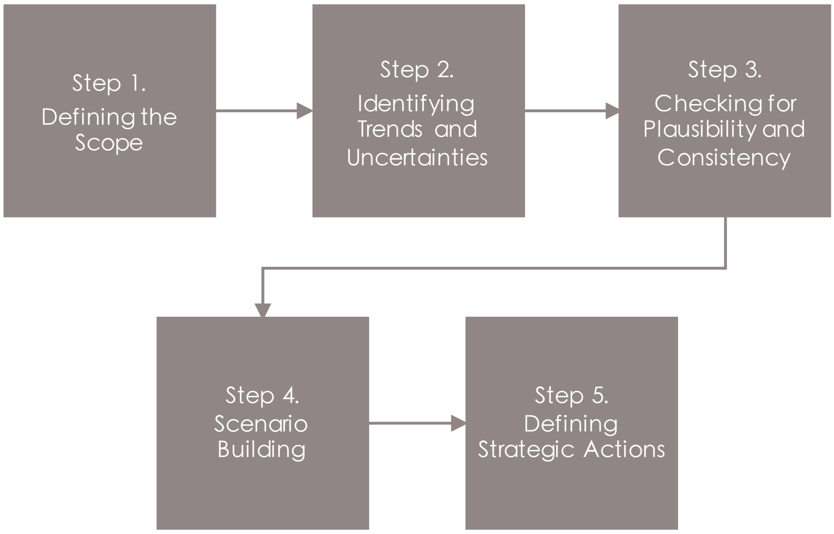

Figure 2.2. An overview of the customized scenario planning framework.

Step 1. Defining the Scope

The initial step is a combination of Schoemaker's (1995) first and second step and the first step of Schwenker and Wulf (2013). Defining the scope is an essential first step of a scenario planning process as it allows the people involved to gain a common understanding of what to include and what the purpose of the scenario planning is (Schoemaker, 1995; Schwenker & Wulf, 2013). To define the scope, the five areas visualized in *Figure 2.3.* will be determined. To easier define the scope, an interpretation of Schwenker and Wulf's (2013) framework 'the framing checklist' will be used, visualized in *Figure 2.3*.

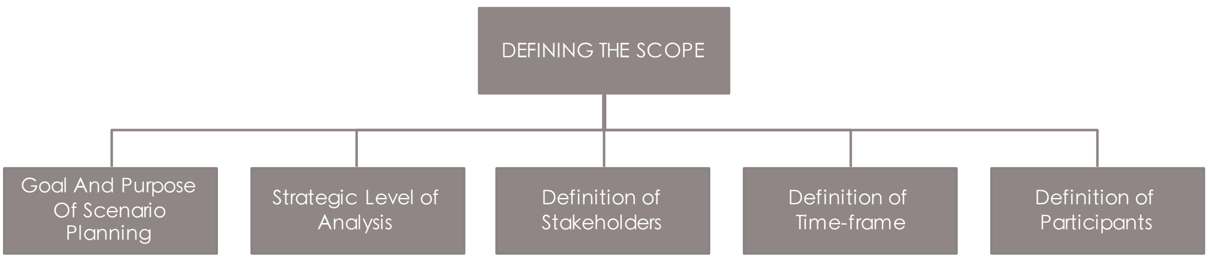

Figure 2.3. Framing Checklist Inspired by Schwenker and Wulf (2013).

Setting a purpose initially is essential since an unclear purpose is one of the common pitfalls in scenario planning (Lindgren & Bandhold, 2003). The strategic level of analysis will be determined, hence, from what perspective within a firm or industry the research is conducted (Schwenker & Wulf, 2013). Relevant stakeholders and participants will also be mapped out, both internally at the partner company and externally. This involves determining stakeholders that will have an interest in the project, and who will be affected by the outcome of it (Schoemaker, 1995). By only having internal stakeholders, the view will be focused solely on the organization with an inside-out focus (Lindgren & Bandhold, 2003). When internal stakeholders are not included in the process it is likely that they will not support the result (Schwenker & Wulf, 2013).

Setting a proper time-frame is critical to ensure realistic scenarios to be developed (Schwenker & Wulf, 2013). There are several aspects to consider since the time-frame should not be too short nor too long. Having a short time-frame, often less than five years, hinders observation of central trends as important changes cannot be predicted in such a short time-frame (Lindgren & Bandhold, 2003). On the other hand, the longer the time-frame, the greater the possible outcomes and the less relevant the planning becomes (Lindgren & Bandhold, 2003).

Participants are those contributing with valuable insights and knowledge to enable identifying development factors. The participants will be both internal and external, allowing for the view on future outcomes to be widened, thus, enhancing the reliability of the scenario planning (Schwenker & Wulf, 2013).

Step 2. Identifying Trends and Uncertainties

Step 2 is rooted in Schoemaker's (1995) third and fourth step as well as in Schwenker and Wulf's (2013) third step. Combining the trend and uncertainty analysis similarly to Schwenker and Wulf (2013) is beneficial mainly as it allows for high efficiency. Also, it was not considered necessary to divide the steps as there are synergies in conducting the analyses simultaneously. In this step, the development factors presented in *Section 4.* are analyzed to identify trends and uncertainties within the three areas of investigation. Analyzing the development factors according to these areas allows for a wide investigation covering the purpose of this research (Schoemaker, 1995).

As outlined earlier in this section, the identification of the development factors is not part of the customized scenario planning framework, instead, they are presented in *Section 4.* after a thematic analysis. An explanation of how the development factors are sorted will be presented in *Section 3.4*. This means that when conducting the second step, the development factors have already been sorted within the three areas of investigation. However, not all development factors are of relevance for the defined scope. For instance, not having a crucial impact on the development of OEMs within the time-frame. Therefore, four criteria are developed to determine which development factors can be labelled trends or uncertainties, and which ones to exclude from the rest of the scenario planning process.

Trend Inclusion Criteria			
1.	2.	3.	4.
Effective Within the Time-Frame	Significant Impact on OEMs in the Industry	Mentioned by 30% of the Experts and/or 30% of the Respondents	The Outcome is Certain
Uncertainty Inclusion Criteria			
1.	2.	3.	4.
Effective Within the Time-Frame	Significant Impact on OEMs in the Industry	Mentioned by 30% of the Experts and/or 30% of the Respondents	The Outcome is Uncertain

Table 2.2. Inclusion Criteria Determining Trends and Uncertainties.

As illustrated in *Table 2.2,* three of the four criteria are equal for both trends and uncertainties, however, the final criterion is what separates a trend from an uncertainty. For a development factor to be considered a trend or an uncertainty, all of these four criteria need to be fulfilled respectively. These criteria are based on the scope defined in the previous step. Firstly, the development factors need to be effective today or within the chosen time-frame. Secondly, the development factor needs to have a significant impact on OEMs in the industry within the time-frame. This means that the strategic actions of OEMs present in the U.S. need to be affected by the outcome of the development factor. The third criterion involves the development factor's number of mentions by the respondents. This criterion can be fulfilled in two ways, either 30% of the respondents in an area of investigation mention the development factor, or, 30% of the experts of the area of investigation mention the development factor. Hence, an expert mentioning a development factor weights higher. Finally, the fourth criterion varies between trends and uncertainties. For a trend, the outcome of the development factor needs to be certain, hence, agreed upon by the respondents. For an uncertainty, the outcome of the development factor needs to be uncertain, hence, the respondents do not agree upon a specific outcome.

This means that for a development factor to be classified as a trend, the first three criteria need to be fulfilled and the outcome of the factor is certain. For a development factor to be classified as an uncertainty, the first three criteria need to be fulfilled alongside an uncertain outcome.

Each identified trend and uncertainty are thereafter explained briefly, including how it fulfills the criteria (Schoemaker, 1995). As the uncertainties lay the foundation for the scenario building, two possible dichotomous outcomes for each uncertainty are identified. Furthermore, to illustrate the impact of each trend and uncertainty and to conclude which uncertainties shape the scenarios, the 'impact/uncertainty grid' is used (Schwenker & Wulf, 2013). Both the degree of impact and uncertainty of each trend and uncertainty is measured relatively. The trend and uncertainty estimated to be the greatest driving force will be set to have the highest impact respectively and the same goes for the level of uncertainty. All development factors are sorted accordingly to their impact and uncertainty in the impact/uncertainty grid, see *Figure 2.4.* The grid contains three sections. The bottom section consists of factors with a relatively minor impact on OEMs, called secondary elements. These are excluded from the scenario planning process, hence, it consists of the development factors not fulfilling the criteria.

The upper left section outlines the trends and the upper right section the uncertainties, as determined above (Schwenker & Wulf, 2013).

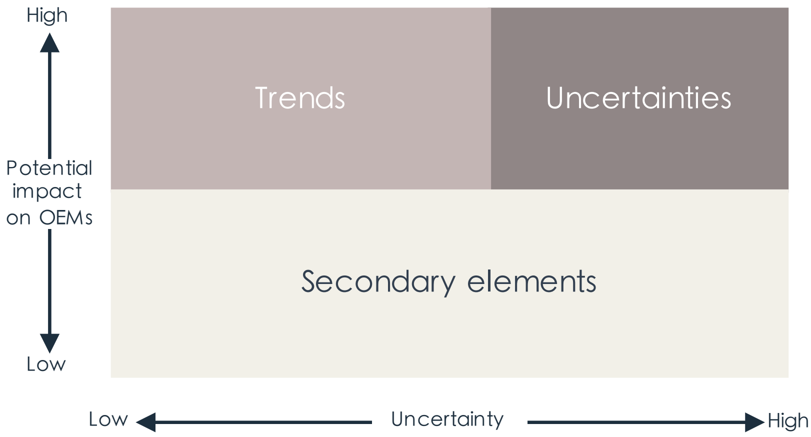

Figure 2.4. Impact/Uncertainty Grid Inspired by Schwenker and Wulf (2013).

Step 3. Checking for Plausibility and Consistency

The third step takes inspiration from Schoemaker's (1995) sixth step as it constitutes of checking for plausibility and consistency among the trends and uncertainties. It is highly necessary to test the correlation between the uncertainties as they might relate to and, be affected by, one another (Schoemaker, 1995). Uncertainties might support each other, be mutually exclusive, or be contradicting, affecting the plausibility of the scenarios. Furthermore, determining the correlations facilitates the scenario building in next step as it results in identifying interconnections between uncertainties. Schoemaker (1995) suggests determining the correlations through a correlation matrix after the uncertainties are identified, see *Table 2.3.* The matrix shows if the occurrence of Uncertainty 1 (U1) will affect the occurrence of Uncertainty 2 (U2), and so on. If the chance of the occurrence increases, there is a positive correlation (+). If the chance decreases, there is a negative correlation (-). If the chance does not change, it is neutral (0), and if the chance is impossible to determine, it is unknown (?). The correlations are determined based on the chosen time-frame, hence, in a longer time-frame, the correlations might change alongside industry evolution and other changes affecting the uncertainties.

Correlation Matrix						
	U1	U2	U3	U4	U5	U6
U1		-	+	-	+	+
U2			-	0	?	-
U3				?	-	+
U4					0	+
U5						?
U6						

Table 2.3. Example of Correlation Matrix Inspired by Schoemaker (1995).

Moreover, the third step in the customized framework includes a trend impact analysis discussing each trend's impact on other trends and uncertainties. Schoemaker (1995) includes this in his third step, however, since the trends also affect the uncertainties and thus the scenarios in various ways, the trend impact analysis is made after analyzing the interconnections between the uncertainties. Since the defined trends have a certain outcome, they will occur regardless of how the uncertainties and consequently scenarios emerge. By exploring each trend's influence over both other trends and uncertainties, additional consistency and plausibility is ensured. Further, these connections will be outlined in each scenario's influence diagram (see *Figure 2.6.*) as well as elaborated in the storylines of each scenario.

Step 4. Scenario Building

The fourth step involves building the different scenarios based on the earlier identified uncertainties and trends. It is highly similar to the fourth step by Schwenker and Wulf (2013), whilst including certain parts from step five and seven in Schoemaker's (1995) process. As described above, Schoemaker (1995) presents three common ways to construct the scenarios. As this research involves identifying trends and uncertainties within three areas of investigation, the second alternative is considered most suitable. This alternative means clustering different uncertainties around two dimensions. By clustering the most impactful uncertainties, uncertainties within all three areas of investigation can be included in the scenarios which is perceived to be of importance. To identify what uncertainties to cluster in the two dimensions, a set of criteria is determined, see *Table 2.4*. Firstly, the uncertainty must have a high impact on OEMs in the industry within the chosen time-frame. The level of impact of the uncertainties are determined in Step 2, thus, measured relative to the other uncertainties. Secondly, all uncertainties in a dimension need to be able to be bundled together. Hence, a dimension consists of the uncertainties where correlation and high impact is identified.

Criteria for Dimensions
The uncertainties must have a high impact on OEMs in the industry within the time-frame
The uncertainties in one dimension must be able to be bundled together

Table 2.4. Criteria for Uncertainties to be Bundled in Two Dimensions.

Upon the two dimensions the scenarios will be built based on a scenario matrix corresponding to the four quadrants as illustrated in *Figure 2.5.* (Schwenker & Wulf, 2013). Since the scenarios are based on dichotomous uncertainties, the dimensions generate four consistent and plausible scenarios (Lindgren & Bandhold, 2003; Schwenker & Wulf, 2013). After clustering the identified uncertainties along two dimensions and putting these dimensions to their extremes, the four scenarios can be formed.

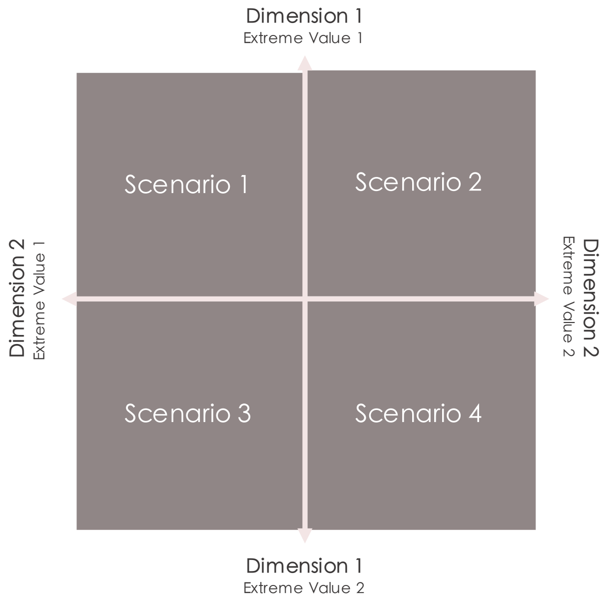

Figure 2.5. Scenario Matrix.

The scenarios are to be described in great detail taking both uncertainties and trends into account. Also, four thorough narratives corresponding to the scenarios are developed. Each scenario will include a description of how the automotive industry will look in the chosen time-frame and what role OEMs will play. Moreover, the development of LIB cell manufacturing as well as the most suitable sourcing mode in each scenario will be highlighted. Based on the four developed scenarios, different sourcing modes will be preferred, however, this is further elaborated in Step 5. As described by Schoemaker (1995), it is necessary to use compelling name and storytelling throughout the description of the scenarios. Storytelling and visualization make the scenarios easily memorable and more trustworthy (Lindgren & Bandhold, 2003). To complement the storylines, each scenario will be illustrated in an influence diagram visualizing the course of action (Schoemaker, 1995; Schwenker and Wulf, 2013). This diagram includes showing how the uncertainties relate to each other, see *Figure 2.6*. Moreover, the relevant trends are also included as they have an impact on the development within the time-frame as well.

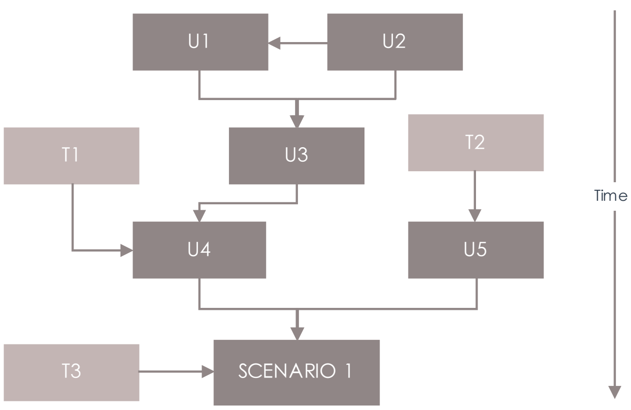

Figure 2.6. Influence Diagram Inspired by Schwenker and Wulf (2013).

Step 5. Defining Strategic Actions

The final step of the customized scenario planning framework is similar to Schwenker and Wulf's (2013) sixth step. In this step, the strategic actions and recommendations will be formulated based on the identified scenarios in the previous step. To define the strategic actions and recommendations, the researchers' interpretations from the theory in *Section 2.1.* will be used to strengthen the arguments. The decision of 'make or buy?' depend on various factors whereby each scenario is suggested a specific sourcing mode. The sourcing continuum presented in *Figure 2.1.* includes a summary of sourcing models, hence, it will be used to visualize the sourcing modes of each scenario.

Schwenker and Wulf (2013) describe that after determining the strategic actions for each scenario, the common elements will be used to formulate a core strategy. This core strategy results in recommendations for how OEMs can strategically prepare for the future challenges, whilst allowing for flexibility to adjust according to the future development.

When the fifth step has been made, the scenario planning process is completed. The scenario planning process results in four potential scenarios showing how the future can develop alongside strategic recommendations on the most suitable sourcing mode for each scenario. Moreover, to allow OEMs to prepare for all future scenarios, a core strategy is formulated enabling OEMs to easily adopt to how the future emerges.

3. METHODOLOGY

The methodology section serves to describe how the research has been conducted. Firstly, the research strategy is outlined, followed by the research design chosen for this research. Thereafter, the data collection and data analysis are described and motivated. Lastly, to ensure the quality of the research, the reliability and validity is discussed alongside the ethical considerations.

3.1. RESEARCH STRATEGY

Based on the research questions and the purpose of this research, a qualitative research strategy was chosen for this research. The two general approaches of research strategies are qualitative and quantitative (Bell, Bryman & Harley, 2019). The qualitative approach was chosen as it is described to be suitable when investigating a dynamic and developing environment, as in this case where OEMs face a high level of uncertainty (Bell et al., 2019). Through a qualitative research strategy, factors affecting the development of the automotive industry and cell manufacturing in the U.S. can be identified and analyzed in-depth. Whilst quantitative research focuses on numerical data and quantification, qualitative research focus on the emphasizing of words and interpretations of its participants (Bell et al., 2019). Identifying trends and uncertainties from relevant actors with valuable expertise is critical for this research. Additionally, the goal is to not exclusively gain information but explanations as well (Bell et al., 2019). The aim is to illustrate the reality where contradictory and ambiguous results can exist, making the qualitative approach highly appropriate.

To gain explanations and insights, the qualitative strategy provides a structure where the perspectives of the respondents can be captured by allowing their viewpoint to be in focus. Moreover, in contrast to quantitative research, the researchers have had a high involvement with the respondents to enhance the understanding and the perspectives of the respondents. The interaction enabled noticing tonality and emphases, reducing the risk of the research being subjective by relying on predetermined impressions of the researchers (Bell et al., 2019). Further, related to the qualitative strategy, the gathered data have been highly unstructured. This enhances the importance of understanding and capturing the meanings and viewpoints of the respondents (Bell et al., 2019).

Typically associated with qualitative research is an inductive approach, in contrast to quantitative research where a deductive approach is common (Bell et al., 2019). The inductive approach generates new theory by analyzing the world whilst the latter tests theory by setting a predetermined hypothesis (Bell et al., 2019). In inductive research, the empirical findings relate back to the relevant theory, and the theory is seen as an outcome generated out of the empirical investigation rather than something anticipated (Bell et al., 2019). This research focuses on the inductive approach, however, it contains certain elements of a deductive approach. More specifically, the research consists of an iterative approach where findings have been connected back and forth to the existing literature as well as the analysis, mostly because of the unstructured nature of the data. This iterative approach is often referred to as an abductive approach (Patel & Davidsson, 2019).

3.2. RESEARCH DESIGN

The research design aims to provide a framework for the data collection and the data analysis (Bell et al., 2019). Hence, the design should be chosen to fit both the collection and the analysis of the data. This research is highly characterized by identifying factors with an influence on the development of LIB cell manufacturing and the demand for EVs. To address the exploratory nature, the chosen research design is scenario planning. This was found suitable as it provides guidelines in how to collect the data and thereafter how to interpret and analyze it. Even though scenario planning is not identified as a traditional research design, it guides the execution of both the data collection phase and the analysis, hence it is argued to be considered the research design.

According to Bell et al. (2019), the research design is important in terms of getting an understanding of a certain phenomenon and its implications over time. In most research, one or more cases are studied either at a single point in time, or different time aspects are compared with each other (Bell et al., 2019). In this case, however, the time aspect is more complex as it takes a future time perspective. Lindgren and Bandhold (2003) describe scenario planning as an efficient tool for investigating uncertain future conditions further favoring a scenario planning design. Moreover, it enables understanding the development systematically, hence, the choice is motivated by the goal and purpose of the research (Lindgren & Bandhold, 2003).

The scenario planning framework used in this research is based upon established frameworks described in the previous section. However, to fit the purpose of this research, a customization of the framework has been developed, see *Figure 3.1*. The customized scenario planning framework was explained extensively in *Section 2.3.1.*, however, how each step has been conducted from a methodology perspective is explained below.

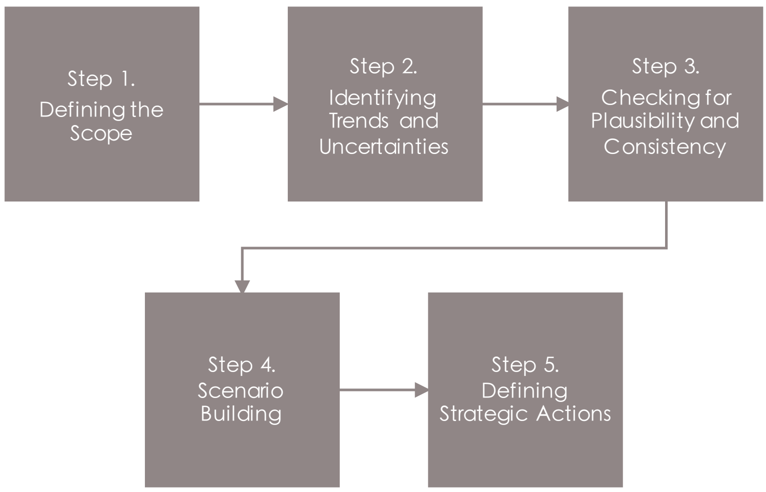

Figure 3.1. An Overview of the Customized Scenario Planning Framework.

The first step consisted of defining the scope which was made by using the 'framing checklist'. As previously explained, this was carried out in the beginning of the research process in collaboration with the partner company, as it lays the foundation of the entire research process.

The second step involved an identification of trends and uncertainties constituting the foundation for the scenario building. The trends and uncertainties were identified from the development factors presented in the empirical findings. Based upon these development factors, trends and uncertainties were identified based on a set of four criteria previously presented in *Table 2.2*. The criteria as well as whether the outcome was certain or uncertain was determined by the researchers, evaluated based on partly the respondents indicating an outcome, partly on logical reasoning sprung out of high involvement in discussions. Thereafter, the trends and uncertainties were mapped out in an impact/uncertainty grid. This illustration was helpful for the forthcoming steps when determining what factors to include in the scenario building. Mapping out the trends and uncertainties was done by the researchers by taking into consideration the perceived relevance discussed by the respondents as well as the respondents' indications.

The third step consisted of checking for plausibility and consistency. This was done both for the uncertainties and the trends. First, the correlations between the uncertainties were outlined, i.e. checking for dependencies. Potential correlations between the uncertainties were needed to take into consideration to ensure plausibility of the scenarios. Determining the correlations was possible due to the researchers having an overview of the research and the context within which each development factor was discussed. In most cases, correlations were mentioned by the respondents. The trends' impact on the uncertainties were also mapped out because they play an important part in how the scenarios turn out. The trend impact analysis was, as in the previous step, determined by the researchers logical reasoning, whilst taking relevant statements of the respondents into account.

In the fourth step, the four possible future scenarios were constructed. The uncertainties determined the two dimensions in the scenario matrix, and consequently shaped the four future scenarios. As explained earlier, the dimensions consist of uncertainties fulfilling the set of criteria presented in *Table 2.4*. Hence, the uncertainties were divided into the two dimensions depending on their correlations as well as their impact determined in the impact/uncertainty grid. Moreover, the four plausible scenarios based on the scenario matrix are described in detail and supported by an influence diagram showing each scenario's course of action. The influence diagram is based upon the correlations between the uncertainties and the trend impact analysis. Each scenario consists of a description on the suitable sourcing mode, the role of the OEMs, and their involvement in the supply chain.

Lastly, in the fifth step, the sourcing mode of each scenario is described and motivated further based upon the theories presented in *Section 2.1*. By combining the theories on sourcing models with the four scenarios, the researchers were able to determine each scenario's most suitable sourcing mode as well as mapping them out along the sourcing continuum. This allowed for strategic actions for each scenario to be defined. Moreover, a core strategy was formulated based upon the researchers' interpretation of the common elements of all strategies. This enabled recommendations for OEMs on how to strategically prepare for future changes today.

Every research design corresponds with certain limitations. Predicting the future is difficult, especially as the world is increasingly uncertain containing a great deal of complexity and volatility. However, scenario planning combines robustness and responsiveness and allowing for flexibility to respond to external changes (Lindgren & Bandhold, 2003). Also, since the data was collected more or less concurrently, the result is a current state of the trends and uncertainties in the industry. However, instead of explaining a phenomenon of a specific time period, the empirical findings are used to construct four plausible future scenarios. Hence, the result of the research enables OEMs to prepare strategic actions for the future possible outcomes. Lastly, a qualitative research of an exploratory character concerns a risk of having to gather a vast amount of data. However, the scenario planning framework sets a structure for how to narrow the data collection into specific areas, whilst still allowing obtaining multiple perspectives.

3.3. DATA COLLECTION

The data collection is a fundamental part of research and what drives the data collection are the research questions (Bell et al., 2019). The data collection consists of mainly primary but also secondary data which collectively have shaped the empirical investigation and consequently the analysis. Combining primary and secondary data was perceived by the researchers to enable a more critical view on identified data, enhancing external validity. The primary data involves qualitative interviews with experts to guide the investigation. The secondary data consists of various reports and articles supporting the primary data collection. Hence, the primary data is the main source of data in this research.

3.3.1. Primary Data

The primary data collection is based on qualitative interviews. Conducting interviews was perceived preferable as it allows for flexibility allowing the respondents to elaborate the answers, which was encouraged considering the purpose of the research (Bell et al., 2019). As this research aims to capture future possible scenarios, it was important to allow the respondent to describe their own thoughts on the future. Moreover, qualitative interviewing emphasizes an open-ended view on the research generating both detailed answers as well as various viewpoints of the respondents (Bell et al., 2019). One disadvantage with the interviews is that the process of execution, transcribing, and analyzing are time-consuming (Bell et al., 2019). However, the advantages of qualitative interviewing were valued higher than the disadvantages.

Semi-Structured Interviews

There are two ways of conducting qualitative interviews, namely unstructured and semi-structured (Bell et al., 2019). The semi-structured interviews were deemed preferable as this research has three predetermined areas of investigation upon which the research is based. Thus, the investigation has a clear focus from the beginning, pointing at semi-structured interviews being preferable as it enables maintaining the focus (Bell et al., 2019). Moreover, this allowed a gathering of both retrospective and current experiences within the three areas (Gioia, Corley & Hamilton, 2013). Before conducting the semi-structured interviews, an interview guide was constructed consisting of a list of questions (Bell et al., 2019). The interview guide, further elaborated below, was designed to enable and ensure the research questions to be answered. Hence, preparing the interview guide was made to ensure the scope of the interview and that certain areas of investigation were covered. The researchers could, however, ask the questions in an assorted order as well as revise and add questions throughout the interview (Bell et al., 2019). The questions were mostly open-ended which was found appropriate since the respondents were encouraged to reply in a way found suitable and connect to related topics. Hence, instead of getting generalizable answers, the respondents could have contradictory answers (Bell et al., 2019). In this case, contradictions in the data is not considered a problem since the research aims to identify several plausible scenarios of the future. Moreover, this allows for a more objective outcome, minimizing the risk of only include confirming evidence (Schoemaker, 1995).

Selection of Respondents

Due to the empirical findings mainly are generated from primary data, it was found necessary to systematically identify relevant respondents. The goal was to identify respondents that enable providing contextual knowledge and together provide a holistic view on the topic of interest (Byrne, 2001). As the sampling relates directly to the findings and the analysis, avoiding biases when selecting respondents is essential (Bell et al., 2019). As Bell et al. (2019) outline, the research questions give an indication of what type of respondents to include in the research. In this case, the areas of investigation (Politics and Trade, Market Development and Technology) clearly indicated whom to interview. The respondents were selected based on their areas of expertise corresponding to one of the three areas of investigation. Even though the contribution of the respondents depends on their area of expertise, they generally contributed to more areas of investigation than their own. For instance, the respondents of Politics and Trade could contribute to both the area of Politics and Trade, as well as to the area of Market Development. There are two reasons for this. Firstly, the areas of investigation are somewhat interconnected and thus discussions over overlap. Secondly, the respondents are also partly selected based on the relevance to the general research topic, naturally resulting in the knowledge and experience overlapping the areas of investigation.

To ensure gathering a wide range of data from respondents with various viewpoints, descriptions of contribution from the respondents were set for the selection phase. The descriptions of contribution are described below in *Table 3.1*. When contacting and selecting respondents, it was important that the distribution between the three areas of investigation was consistent. Considering this research view on the future development in terms of identifying trends and uncertainties, there were no criterion of experience for the respondents. This, as it is explained that different stakeholders and participants should be involved in the scenario planning process, to widen the view and gain different perspectives (Schoemaker, 1995). By including respondents with varying experiences, the view on the future outcome was widened, enhancing the reliability (Schwenker & Wulf, 2013).

Area / Contribution	Politics and Trade	Market Development	Technology
Area of expertise	Expertise within regulations in regards to politics and trade	Market development in the industry of EVs/Strategic viewpoint on Business Development	Development of the LIB and/or development of electrification
Purpose	Contribute with insight in politics and trade and politics influencing the industries of EVs and LIB cells	Contribute with insights in how the industry works, how it will develop, and markets development in terms of electrification	Contribute with insights in the technical development, its possibilities and constraints
Example of Titles	Advisor Trade Policy Researcher within International Business and Trade	Sales Forecasting Executive Position EV Expert	Battery Expert Researcher within LIB
Example of Organizations	Universities OEM´s Trade Department Trade Organization	OEM´s Sales Department Interbranch Organization Cell Manufacturer	OEM´s Technology Department Universities

Table 3.1. Description of Contributions for the Selection of Respondents.

The respondents are from the partner company, universities, and other organizations and are defined to be experts within one of the three areas of investigation. These generated multiple perspectives on the topic of interest due to various backgrounds and experiences. Regardless of position and employer, all respondents are considered to contribute to the research enabling answering the research questions.

The respondents were selected based on both purposive sampling and snowball sampling. Purposive sampling means that the researchers include respondents in a strategic way, and that respondents are chosen with the research goal in mind (Bell et al., 2019). In this case, the description of contribution worked as criteria for selecting respondents with relevance of whom could contribute with valuable insights to the research. Since purposive sampling implies that one cannot select respondents on a random basis, the predetermined description of contributions ensured a variation in characteristics among the respondents. The sampling was made by recommendations from the partner company, searching the internet, and reading reports and research papers. Based upon this, some respondents recommended suitable contacts within their network, resulting in so called snowball sampling. Snowball sampling means that contact is established with new respondents through earlier identified respondents (Bell et al., 2019). This was an appreciated complement to the purposive sampling as it provided respondents not likely identified otherwise.

	Name	Company	Position	Channel	Date	Length of interview
Politics and Trade	Claes Alvstam	School of Business, Economics, and Law	Professor Emeritus, Economic Geography	Face-to-face	2020-02-26	1:11:17
	Cecilia Malmström	School of Business, Economics, and Law	Visiting Lecturer, former EU Commissioner	Face-to-face	2020-03-03	46:43
	Michael Koch	KommersKollegium	Head of International Trade Development	Online Conference Call	2020-03-16	52:03
	Ingrid Berglund	Svenskt Näringsliv	Advisor Trade Policy	Online Conference Call	2020-03-24	55:17
	Jennifer Varney	Volvo Group	CPM Global Trade Management Program	Face-to-face	2020-03-02	59:17
	Troy Burch	Volvo Group	NA Trade Barrier Coordinator	Online Conference Call	2020-03-13	59:13
	Jonathan Miller	Volvo Group	Senior Vice President Public Affairs	Online Conference Call	2020-03-13	59:13
Market Development	Anders Kellström	Volvo Group	Senior Product Planning Manager, Electromobility	Face-to-face	2020-03-13	57:36
	Anders Grauers	Swedish Electromobility Center	EV Expert	Online Conference Call	2020-03-16	59:07
	Respondent A	N/A	EV Expert	Online Conference Call	2020-03-11	56:01
	Bo Normark	InnoEnergy	Industrial Strategy Executive	Online Conference Call	2020-03-17	54:27
	Klaus Silfvenius	Motorbranschens Riksförbund MRF	Manager Automotive Sales	Online Conference Call	2020-03-18	52:02
	Pierre Larsson	Northvolt	Logistics Coordinator	Online Conference Call	2020-04-06	39:13
	Zied Abdellaoui	Volvo Group	Senior Project Buyer Energy Storage Systems	Face-to-face	2020-02-28	32:54
	Vivianne Gillman	Business Sweden	Director of Business Development, Region Americas	Online Conference Call	2020-04-03	40:05
Technology	Greger Ledung	Energimyndigheten	Battery Expert	Online Conference Call	2020-03-17	1:04:43
	Ragunath Balakrishnan	Volvo Group	System Architect Traction Batteries	Online Conference Call	2020-03-19	56:55
	Sophie Tintignac	Volvo Group	Research Engineer, Battery Specialist	Online Conference Call	2020-03-18	1:07:57
	Gustav Åvall	Chalmers University of Technology	PhD Student, Materials Physics	Online Conference Call	2020-03-17	42:12
	Stanley Whittingham	Binghamton University	Distinguished professor of Chemistry. Inventor of LIB, 2019 Nobel Laureate	Online Conference Call	2020-03-23	40:29
	Jens Groot	Volvo Group	Energy Storage Systems Specialist	Online Conference Call	2020-03-18	46:57

Table 3.2. Respondents within the Three Areas of Investigation.

Table 3.2. shows the 21 respondents identified and interviewed. The first group, experts within Politics and Trade, includes seven respondents. The second group, Market Development, includes eight respondents. Lastly, the third group, Technology, includes six respondents. In contrast to quantitative research, qualitative research does not have generalizability as its ultimate goal, thus, a smaller sampling size is not an issue (Marshall, 1996). An appropriate sample size is instead determined by if the research questions are adequately answered, which this number of respondents were perceived to do (Marshall, 1996).

Interview Guide

An interview guide consists of themes and subjects to be covered in the interviews (Bell et al., 2019). In this case, three interview guides were constructed prior to the interviews. The questions were based on experienced difficulties within the three areas of investigation. First, a main interview guide was developed with questions applicable regardless of area of investigation. These questions were related to the overarching scope of the research. Thereafter, the interview guide was developed based on the three different areas, resulting in three interview guides. Even though the three interview guides differed, the questions were asked following the same structure. Further, as the questions were developed with the aim of answering the research questions, the interview guides were based on the similar themes to simplify the analysis. Before initiating the interview process, the guides were approved by the partner company, ensuring the questions to be of relevance for the scope. An overview of the guides is available in *Appendix A*. As described by Bell et al. (2019), the interview guide was used as a guideline of how the interview would be performed, but generally, the order of the questions was changed as the respondents often made own connections between the subjects of the questions. The researchers often asked follow-up questions to motivate the respondent to elaborate further.

Prior to the interviews, the respondents were asked if they wanted to receive the interview guide beforehand, to ensure the scope of the interview was agreed upon. A few respondents requested this as they deemed it would enhance the quality of the interview. However, in the cases where the respondents did not need it beforehand, the quality of the interview was still perceived high, mainly due to the respondents fitting into the predetermined descriptions of contribution.

There are critical aspects with qualitative interviewing that is important to consider. Firstly, preparing the interview guide and asking the right questions is important as it has an impact on the respondents' answers. It is important that the questions are asked in an order so it creates a good flow, and that before each interview a proper preparation is made (Bell et al., 2019). Furthermore, qualitative research is criticized for being too subjective (Bell et al., 2019). Therefore, it was considered essential to not ask leading questions nor try to interpret the data subjectively. In addition, working systematically with a critical and cautious mindset was perceived to minimize these concerns.

Interview Practicalities

To ensure the quality of the primary data collection, a few practicalities are favorable to cover. As is shown in *Table 3.2.*, five interviews were conducted face-to-face. The other 16 interviews were held via online conference calls (e.g. Skype or Google Hangout). As is pointed out by Bell et al. (2019), face-to-face interviews used to be preferred, but as technologies interfere more and more in everyday interactions, this is no longer the case. The researchers agree to the advantages available in face-to-face interviews, such as noticing facial expressions and body languages, however, three factors had a significant effect on the type of interview channel used. Firstly, geographical distance affected the type of channel as several respondents are based in other cities. Secondly, the interviews were sometime scheduled tightly, suggesting that online conferences calls enhanced efficiency. Thirdly, due to the spreading of the Covid-19 pandemic occurring at the time, people were encouraged to stay at home and keep a social distance.

Both researchers were present during the interviews. This, to enhance consistency and to gain an exhaustive understanding to easier analyze the collected data. One researcher held the interviews whilst the other researcher focused on the process of taking notes. Alongside this, with the consent of the respondents, the interviews were recorded to enhance quality by enabling a more thorough examination of the data whilst reducing intuitive memories (Bell et al., 2019). Even though transcribing the interviews is time-consuming it was considered an important step in the process to ease the identification of themes and consequently development factors. To enhance efficiency, the researchers conducted the transcribing in parallel and thereby did not participate in the transcribing of all interviews.

Interpretations and elaborations are important in qualitative interviews, therefore, language can create barriers. The researchers are Swedish native speaking and fluent in English. For this reason, all interviews with Swedish speaking respondents were conducted in Swedish to allow for greater elaboration and expressing of opinions more freely. The other interviews were conducted in English, however, language hinders or misinterpretations were not perceived to occur.

As is presented in *Table 3.2.*, the length of the interviews varied between approximately half an hour to just over one hour. This mostly depend on the availability of the respondent and not of knowledge or level of elaboration. According to Bell et al. (2019), there is often a great variation in the length of the interviews, however, it should not be assumed that shorter interviews are of inferior quality. The researchers share this opinion and believe some of the shorter interviews to have generated the most interesting and important findings.

3.3.2. Secondary Data

Even if this qualitative research primarily focuses on semi-structured interviews, secondary data is also included in the empirical findings. Secondary data was considered beneficial as it allows for the development factors to become more exhaustive making the scenario planning of higher quality. According to Bell et al. (2019), taking advantage of secondary data saves both time and money. Also, secondary data offers an opportunity of using high-quality data based on rigorous research. Secondary analysis can be of both quantitative and qualitative nature (Bell et al., 2019). Due to the qualitative research strategy, the secondary data has been gathered through a qualitative data collection. Secondary data was perceived to enhance reliability of the scenario planning process as it widened the objectivity of the identified factors (Schwenker & Wulf, 2013). Moreover, it seems highly relevant to capitalize on already existing data as it provides great input into this research whilst not being too time-consuming.

The data was collected through searching the internet which is a common way to gather secondary data (Bell et al., 2019). The collection of secondary data mainly includes three types, articles, reports, and press releases, which resulted in a thorough collection of a wide range of data. Firstly, the articles collected through databases had to fulfill the criterion of being peer-reviewed to ensure quality. Secondly, the reports collected were mainly consultancy reports made by management consultancies or benchmark companies. Thirdly, the press releases involved news articles about OEMs, cell manufacturers, or their industries playing an important part in the research. These are mainly from OEMs' own websites or websites focusing on the automotive industry or EVs. The quality of the two latter types was deemed ensured through the use of prominent sources as well as triangulation.

The collection of secondary data was performed both prior to the interviews and afterwards. This, as there are two purposes of the secondary data. Firstly, using existing research and determining what is already known about the evolution of the industry is used as a guideline when gathering primary data. Secondly, existing research is also used to complement the primary data collected in the interviews. Either to find support in respondents' statements, or to more extensively describe the development factors by complementing the data. Hence, the process of collecting secondary data can be characterized by an iterative approach.

3.4. DATA ANALYSIS

Data analysis fundamentally consists of making the collected data manageable and comprehensible (Bell et al., 2019). It incorporates several different elements and, as the validity of the research to a large extent relies on the analysis, a structured process is essential (Bell et al., 2019). As previously described, scenario planning is the framework used for both collecting and analyzing the data. Since the aim of the research is to generate four plausible scenarios of the future, the scenario planning framework provided guidelines on how to build scenarios from the gathered and analyzed data. To enable analyzing the collected data, the data was sorted into different development factors within the three areas of investigation. The process of the data sorting is further elaborated below.

Data analysis is considered a main difficulty in qualitative research as it usually generates large amounts of unstructured data (Bell et al., 2019). Therefore, it is important to choose a methodology that facilitates how to initiate the analysis of the data. According to Bell et al. (2019), there are few established methods for this, however, they present two strategies for analyzing qualitative data, grounded theory and thematic theory. Even though these strategies share common elements, the preferred and chosen strategy for this research was thematic analysis.

Braun and Clarke (2006) describe the thematic analysis to be a foundational method for qualitative analysis. Thematic analysis is a method for identifying, analyzing, and describing themes within data (Braun & Clarke, 2006). As stated in the research strategy, an iteration has been made between the collected data and the analysis. This is, according to Bell et al. (2019), a common approach in qualitative analysis. It was considered appropriate as the research is of a rather exploratory character investigating several areas. The thematic analysis has the nature of a theoretical approach, meaning that the researchers' analytical interest has driven the process (Braun & Clarke, 2006). Braun and Clarke (2006) describe that the choice between a theoretical or an inductive thematic analysis depend on how and why the analysis is made. The inductive analysis is characterized by the research questions evolving throughout the process (Braun & Clarke, 2006). Hence, as this research focuses on specific research questions from start, the nature of the analysis is of a more theoretical nature (Braun & Clarke, 2006).

Since the analysis had an iterative approach, the thematic analysis was performed throughout the data collection phase to identify themes forming the development factors presented in empirical findings. The thematic analysis involves identifying themes through coding. Coding is the process of breaking data into component parts given specific names (Bell et al., 2019). To identify themes, Bell et al. (2019) underline the importance of looking for repetitions, i.e. topics being discussed recurrently by the respondents. The thematic analysis consisted of two analytical stages. First, after being familiarized with the data, initial codes were defined (Braun & Clarke, 2006). This step was made continuously throughout the gathering and transcribing of primary data. Thereafter, the themes were determined by clustering codes together, generating various development factors within the three areas of investigation as presented in *Section 4*. This was made through color coding, which was perceived an easy and efficient method. The colors corresponded to broader topics discussed by the respondents, i.e. more overarching themes. This methodology was perceived as a structured way making the big amount of unstructured data manageable. Moreover, the thematic analysis was made collectively by the two researchers to enhance internal reliability and ensure a mutual interpretation.

Bell et al. (2019) describe a few disadvantages with coding. First, by selecting fragments from a respondent's transcription, losing the context suggests a risk of losing the meaning. However, this risk was reduced because the researchers verified the themes so the meaning was kept intact. Moreover, an iterative approach proposes the risk of generating too much data (Bell et al., 2019). However, the scenario planning framework enabled constantly revising the data and connecting it to the desired outcome, minimizing this risk.

3.5. RESEARCH QUALITY

Even though potential issues concerning research quality have been discussed to a certain extent throughout the methodology, it was perceived essential to further elaborate these issues as it is of great importance for the researchers to ensure high quality. Even though it is discussed what quality measures to evaluate in qualitative research, reliability and validity are most common (Bell et al., 2019). Moreover, these measures are perceived suitable since the goal of this research is not to test hypotheses or draw generalizable conclusions. The two quality measures chosen are discussed below.

3.5.1. Reliability

External reliability

External reliability looks upon the degree to which the research can be replicated (Bell et al., 2019). As the prerequisites and the specific settings of a research are impossible to 'freeze', measuring the external reliability is difficult. Since the respondents play a crucial part in qualitative research, the respondents' names, positions, and employers are presented. This has been confirmed by all respondents, except from one that is referred to as Respondent A (A for anonymous). Also, the interview guides are provided to facilitate replicability and enhance transparency. To enhance external reliability further, the methodological choices have been explained and motivated with the ambition of creating a great understanding for the reader. The transparency is enhanced by ensuring thorough explanations of each methodological process.

Internal reliability

In qualitative research, internal reliability concerns the consistency of the researchers (Bell et al., 2019). A high level of understanding among the researchers indicates internal reliability of high quality. Thus, it is important that the researchers agree upon empirical findings and share the view on the analyzed data to enable drawing conclusions. Since both researchers have been highly involved in all stages of the research process, the internal reliability is perceived to be high. Also, as explained earlier, the recording and transcribing of interviews have reduced the risk of individual interpretations of the data. This concern was also eliminated by keeping an analytical and aware mindset and communicating openly, both internally between the two researchers and externally toward the stakeholders.

3.5.2. Validity

Internal validity

Internal validity describes the connection between the empirical findings and the theories, hence, the credibility of the research (Bell et al., 2019). Bell et al. (2019) argue that qualitative research usually enhances internal validity because a deep and close relationship with respondents, as in this case, allows for a high level of agreement between findings and theoretical concepts. In this case, defining the research questions properly and ensuring they are answered have increased the internal validity. Moreover, by using inclusion criteria and predetermined qualifications throughout the research process, it is perceived that the credibility of the research is high.

External validity

Another aspect is to which degree the findings are generalizable, measured by external validity. Bell et al. (2019) describe this issue as problematic in qualitative researches as it usually involves small samples. In this case, since the research is made in collaboration with a partner company this issue is of great importance for the researchers. It was therefore important to make a thorough and appropriate interview guide to allow the respondents to answer in a general way. The respondents were informed that the research was made for OEMs in general, and not the partner company in particular. Moreover, the systematic sampling approach, triangulation, and proper documentation enhanced the generalizability (Leung, 2015). Since the research is made for OEMs in general and merely with support from the partner company, the external generalizability was perceived enhanced. However, conducting qualitative research does not include testing hypotheses, pointing at statistical generalizability never was the goal. By keeping these aspects in mind, the analysis is performed critically ensuring that generalization only is made where possible.

3.6. ETHICAL CONSIDERATIONS

When conducting research, it is crucial to acknowledge ethical considerations (Bell et al., 2019). In this research, the most relevant considerations to raise are between the researchers and the respondents. Bell et al. (2019) argue that only when being aware of the ethical issues that arise in research, informed decisions can be made. There are four areas within which ethical issues recurrently arise, these are discussed below (Bell et al., 2019).

In terms of **avoidance of harm**, qualitative researches often relate to issues of confidentiality and anonymity (Bell et al., 2019). Direct quotations or references propose a risk of harming the respondent's reputation. Therefore, the researchers have asked the respondents to assess and confirm their quotations. As stated above, all respondents apart from one have agreed upon their names, positions, and employers to be outlined in the research. The respondent not comfortable with disclosing this information has been named Respondent A. The position of Respondent A was defined together with, and thus confirmed by, the respondent. Lastly, the subject of this research is not seen as harmful, nor does it include personal opinions about the roles or workplaces of the respondents, minimizing this concern.

The issue of **informed consent** aims to cover the risk of not having fully informed the respondents on all information possible regarding the research in order for them to make an acquainted decision on their participation in the research (Bell et al., 2019). This issue is perceived to be diminished as the purpose and goal of the research were communicated on two occasions. Firstly, when inquiring about the respondents' participation the researchers communicated all relevant information. Secondly, every interview commenced with an introduction on the subject as well as an explanation of the background and purpose of the research. However, disclosing all information possible is difficult to guarantee but it is the researchers believe that the respondents were able to make well-informed decisions. This issue relates to the issue of **privacy**, and Bell et al. (2019) argue that just because consent to participate is given by the respondent, there might still be a desire to not answer certain questions. Bell et al. (2019) mention that this is common when questions close to private matters are asked, which has not been the case in this research. Nonetheless, the respondents were initially informed that they could skip any question, regardless of reason.

Finally, **preventing deception** occurs when researchers falsely describe their research, misleading the respondents (Bell et al., 2019). Again, this risk was perceived minimized as there has been a full disclosure on the background, purpose, and goal of the research.

4. EMPIRICAL FINDINGS

This section consists of presenting the development factors, identified in the primary data collection and defined through a thematic analysis. As described earlier, the gathering of the data consists of primary data collection as well as a secondary data collection. The development factors have emerged through the primary data whilst being further explored by secondary data integrated into the description of the development factors. The development factors identified are presented within the three overarching areas of investigation: politics and trade, market development, and technology, however, they are not presented in any particular order. Each development factor is summarized briefly to ease the overview of development factors in relation to the purpose of the research.

4.1. DEVELOPMENT FACTORS WITHIN POLITICS AND TRADE

Within the area of politics and trade, nine development factors have been identified through the interviews. The development factors correspond to the topics covered in the interviews and have been sorted accordingly to the area of investigation. The nine development factors within politics and trade are Environmental Regulations, Sustainable States, USMCA in Force, Ratification of USMCA, Dysfunctional Judiciary in WTO, Exemptions in USMCA, RVC Requirements, Protectionism, and Presidential Impact.

4.1.1. Environmental Regulations

"In general, we see a deregulation of environmental regulations under the current president which have an impact on the incentives toward an electrified fleet of vehicles/.../" – Gillman

Low fuel emission policies enforced by the former president Obama has been pulled back by President Trump (Statista, 2020a). Gillman argues that this is a potential bottleneck for the shift toward EVs. As a consequence of the deregulations, a decline in demand for EVs could be identified in the U.S. in 2019 (European Battery Alliance, 2020a). On the contrary, Europe enforced more incentives in 2019 which caused EV sales to increase with 44% (European Battery Alliance, 2020a). Kellström states further that a regulatory push in the U.S. toward lower CO_2 emissions, such as higher fuel taxes, significantly would impact customers to make the shift toward EVs.

Koch and Varney mention the lack of financial incentives for EVs in the U.S. and they point out the fact that the U.S. is a large oil producer, causing CO_2 emissions regulations not to be of big interest for the country. Varney says that a regulatory push is necessary and mentions that the big access of petrol in the U.S. is a reason for the low fuel prices further constituting a hinder for the electrification of vehicles. Malmström and Grauers both identify the lack of incentives to make the shift toward EVs in the country and agree with one of the main reasons being the low fuel prices. Grauers compares the U.S. with Europe claiming that a break-even for purchasing an EV is reached much earlier in Europe because of higher fuel taxes.

Kellström identifies a need for engagement on a high political level to get the country on the right path. He argues that if taxes on CO_2 emissions were higher, the playfield would be different. Europe is an example where a regulatory push is forcing the vehicle manufacturers to lower their CO_2 emissions

(European Commission, 2020). This is also mentioned by many respondents and Europe is an example where a regulatory push is forcing OEMs to sell EVs and that it puts a lot of pressure on the OEMs.

Grauers argues that this is not as easy in the U.S. to get the government involved in the business environment. In Europe, there is an expectation for the governments to push firms in the right direction, however, in the U.S. it is not as acceptable for the government to interfere with business, he says.

Environmental regulations affect the shift toward the electrification of vehicles. The respondents argue that this factor highly impacts the demand for EVs. Especially important to consider in the U.S. is low fuel taxes that result in low fuel prices, deregulations of CO_2 emissions, and weak financial incentives from the government.

4.1.2. Sustainable States

The respondents generally believe that sustainable development in the U.S. is going in the wrong direction as environmental regulations are being withdrawn at the federal level. However, the respondents argue that at the state level, an intensified push toward EVs can be identified and that some states will continue to make progression in sustainability measures. Koch describes that the U.S. is fragmented, and some states have a high level of engagement in environmental politics. The respondents describe that it will be different degrees of sustainability compliance laws from state to state. Respondent A mentions that the EU's strategic view on electrification is not present on the federal level in the U.S. However, many respondents mention that both states and firms have their own policies and regulations considering sustainability. Malmström explains that even though the U.S. on a federal level has withdrawn from the Paris Agreement, many states still consider themselves committed.

"/.../ But then there are many states that take their own initiative and they are allowed to put their own regulations on the environment side as long as they are sharper than the federal ones. So, there are state-level initiatives that override the federal-level deregulations." – Gillman

Many respondents mentioned California as an example of a state that has stricter regulations toward CO_2 emissions, and they are leading a group of 'zero emission vehicle states' (ZEV). As of today, ten states are included in the 'ZEV states' and they are all working together to support EVs, these are California, Connecticut, Maryland, Massachusetts, Maine, New Jersey, New York, Oregon, Rhode Island, and Vermont (IEA, 2019; ZEV States, 2020). The ZEV states work with the intention of changing the trajectory of the automotive industry, since it is one of the largest sources of greenhouse gas emissions, by setting higher demands on emissions (C2ES, 2019). The states have enforced greenhouse gas emission standards stricter than the standards on a federal level, putting enhanced requirements on OEMs (C2ES, 2019). Whittingham explains that, since California is the fifth largest economy in the world, its regulations have a great impact. More specifically, the regulations of California impact the rest of the country, and especially the democratic states, i.e. the blue states, he says. Moreover, Whittingham explains that industries go their own way and do not depend a lot on federal laws and regulations.

"The blue states are going green and most of the OEMs follow the blue standards." – Whittingham

The respondents discuss the existence of a regulatory push toward sustainable solutions in some states in the U.S. Ten states, the ZEV states, are working to enhance the attractiveness of EVs. These states affect the demand for EVs in the U.S., and respondents argue that several firms and states in the U.S. emphasize the importance of sustainable solutions.

4.1.3. USMCA in Force

USMCA was frequently discussed by several respondents. USMCA is a free trade agreement, but the conditions for free trade are limited. The new agreement covers new rules in several industries and sectors, however, the automotive industry faces the most significant changes (Alanis et al., 2018). The automotive industry has a requirement of 70-75% regional value content (RVC). USMCA implies that if failing the RVC requirements, OEMs need to pay tariffs when trading vehicles within North America (USTR, 2019). The new stringent rules will imply a noticeable period of adjustments for the automotive industry (Alanis et al., 2018). Having a high RVC requirement implies the risk for OEMs to receive higher costs as they import a substantial number of components. Several of the respondents discussed that this will affect the consumers because the prices of the vehicles will likely increase due to the tariffs.

"The characteristic of these types of protectionist trade policies is that the costs are deferred onto the consumer sooner or later." – Alvstam

Malmström argues that the new free trade agreement is based on political reasons not economical and the Trump administration wants to show their accomplishments. Several of the respondents agree that high customs seldom are a good idea since it implies higher costs for both firms and customers. Koch is worried about the effects of the new trade agreement and means that it is not economically reasonable to regulate regional manufacturing. He stresses that trade and manufacturing are supposed to happen naturally.

"OEMs in different parts of the world are, due to regulations, forced to spread their final assemblies in different countries. That is not business economically reasonable." – Koch

A recurring topic during the interviews was the fact that the U.S. also has individual free trade agreements with several countries around the world, so-called bilateral agreements. This implies free trade with a specific country to avoid customs (USTR, 2020). This could be a way to bring a component into the country duty-free. Varney and Burch discussed that the vehicles would still not qualify for moving freely within North America, but it at least allows the imported components to avoid customs. Alvstam and Koch state that it is more likely that bilateral agreements will be enforced between the U.S. and the rest of the world than free trade agreements.

With USMCA in force, the automotive industry will face substantial challenges. More specifically, it will be difficult to reach the RVC requirements because the supply of LIB cells is not present domestically. If not meeting the RVC requirements, OEMs need to pay high tariffs, resulting in higher prices for the end-consumer. However, bilateral agreements create an opportunity of bringing in a component duty-free. One important note mentioned by the respondents is that USMCA is not enforced based on economic reasons but instead political.

4.1.4. Ratification of USMCA

A question under discussion was whether USMCA could be withdrawn. Varney states that since USMCA has not been ratified by Canada yet it is not enforced. Hence, there is a chance that Canada does not ratify it, and North America will remain under the current rules of NAFTA. Malmström gives a straightforward answer to if there is a chance of Canada not ratifying the agreement:

"No, it is already voted in the Congress. They won't tear it up again. After all, the U.S. has ratified and Mexico too. Canada is not in a hurry since there are no improvements for them in the new agreement." – Malmström

Miller also stresses that USMCA will come into force, however, he believes that Canada is not completely satisfied with the agreement, whereby the country has not ratified yet. Alvstam states that Mexico has not spent time arguing about details but instead been content with having a free trade agreement in place. According to both Koch and Berglund, Canada, just as Mexico, does not have any other option than to accept the agreement since the alternative with high customs is worse due to the large number of goods that are traded between the countries.

There is also a concern about USMCA being slightly unpredictable. For instance, Berglund mentions that there is a clause in the agreement stating that it will be effective for 16 years and be revised every six years. She describes it to create a high level of unpredictability generating concern for firms.

The respondents discussed whether or not USMCA would be ratified by Canada and if the agreement could be withdrawn. Several respondents believed that Canada will ratify it, thus resulting in the free trade agreement being effective. Throughout the research process, after the interviews were conducted, Canada ratified the agreement, meaning that USMCA will come in force in the near future.

4.1.5. Dysfunctional Judiciary in WTO

The current instability of WTO was a recurring topic by the respondents. The World Trade Organization (WTO) is the world's global international organization dealing with trade agreements among nations (World Trade Organization, 2020a). WTO aims to reduce obstacles for global trade and provide legal frameworks to implement and monitor trade agreements (World Trade Organization, 2020b). WTO also has the role of settling disputes arising with the agreements being implemented (World Trade Organization, 2020b). However, since December 2019, two of the three member quorum in the appellate body of WTO has been vacant, and the judiciary has been dysfunctional (Tirkey, 2020). The reason for the vacant position is that the U.S. is blocking appointments to fill the vacancies.

The reason why the dysfunctional WTO was a topic of discussion was because of a discussion on whether USMCA manipulates trade. Koch and Malmström both express their concerns with WTO being dysfunctional and not being able to fulfill its role. They point out how important it is to have a common independent judiciary to solve conflicts between countries. Some respondents believe that some of the new rules in the agreement goes against free trade. Malmström, Koch, and Berglund mention that USMCA can imply that the U.S. is prosecuting managed trade which is against the regulations of WTO. However, this accusation cannot be tested nor proved since the WTO judiciary is not working right now. Furthermore, differing interpretations of trade agreements can lead to conflicts between countries, which cannot be solved by an objective party either.

The dysfunctional judiciary in WTO can be a great concern for countries. Especially, it can be a concern with the new trade agreement USMCA, since it might lead to conflicts between countries, thus, require an independent judiciary.

4.1.6. Exemptions in USMCA

One topic of discussion was lobbying for exemptions in USMCA. This means that if not all components needed for a specific product are available in a country and importing from another country is needed, a firm can lobby for an exemption in trade agreements. Hence, in the case of USMCA, some respondents discussed if it might be possible for OEMs to get an exemption on LIB cells if it turns out that they are not available in the country.

”If OEMs can convince the government that it doesn’t hurt them if the LIB cells are imported from Asia because they are going to keep everything else local, OEMs can be allowed to continue to import from Asia. And that’s the best place to get them.” – Varney

According to Burch and Miller, however, there is no possibility of this type of exemption in USMCA which affects the sourcing of LIB cells. Burch argues that it is necessary to invest in cell manufacturing to localize production or for OEMs to simply make the cells in-house.

Due to the circumstances of a deficit of LIB cells in the U.S., a common topic of discussion was the possibility to exempt out the specific component from the USMCA requirements. However, this was confirmed by a couple of respondents, who are experts within this area, to not be possible.

4.1.7. RVC Requirements

Even though USMCA affects many sectors, it is explained that the automotive industry faces the most severe trade regulations (Alanis et al., 2018). Many OEMs will not be able to reach the RVC requirements and are thus forced to pay tariffs (Alanis et al., 2018). Varney argues that so far, the production of EVs is not that extensive in the U.S. whereby it will be possible to take on additional tariffs. However, as soon as the volumes go up, OEMs need to revise their decision. In the end, it will not be profitable to produce EVs unless 70% of the components are sourced locally. Abdellaoui states that in the end, the only way to meet RVC requirements is to localize the cell.

”Until the batteries get localized, OEMs are dead in the water. OEMs are gonna have to eat that tariff, or pass it on to their customers and not sell a single vehicle, until the batteries get localized.” – Varney

Whether or not OEMs are able to source the LIB cells domestically will have an impact on their competitiveness. If not, the two available options OEMs have is to either pass the tariff on to the customer by increasing the price of the vehicle, or paying the tariff themselves and hence reducing the margins. According to Alvstam, because of inertia in the industry, firms do not move easily. It has to do with several things, such as the competencies and technical infrastructure, and he means that in this case, it might be better to take the extra cost. Koch agrees and states that taking the cost will be an economic assessment that the OEMs will make by calculating what is best for them.

According to Varney, OEMs will need to pay the tariffs because the customers will not agree to pay a higher price unless they really want the specific brand. Silfvenius argues that, in general, the smaller the customer, the more brand loyal they are. Most of the customers, especially those of CVs, are brand loyal except for big shipping firms who chose vehicles based on price, he says. Kellström and Whittingham both add that it is important to work with the same sustainability goals globally to not risk losing brand perception. Whittingham states that many American firms develop sustainable solutions due to stricter requirements of overseas markets.

Varney says that the issue of meeting RVC requirements is only critical right now, 15-20 years from now it will not be an issue anymore. She argues that it will be enough production in enough places that

OEMs would reasonably get whatever they need without too much pain and suffering. However, it is more responsible for a firm to invest in cell manufacturing now, not later on, she states.

There are risks involved with OEMs failing to meet the RVC requirements in the new agreement USMCA. Cell manufacturing does not exist to a sufficient degree today causing the OEMs to import cells and pay the tariffs which in turn results in higher prices for the end-consumer. Whether customers are brand loyal enough to still purchase a specific brand is not confirmed.

4.1.8. Protectionism

According to Kellström, there is an increase in protectionism in the world, where customs and nationalism are becoming more common. He believes this will affect the production of LIB cells in the U.S. as well. The tendencies with increased protectionism are also mentioned by Koch. He identifies a risk of increased protectionism and explains that the rationality of having content from different parts of the world is how a firm becomes competitive. Gillman stresses that having it locally produced will result in an increase in costs and maybe even less quality.

"It is essential for a product to have content from different parts of the world in order to be competitive." – Koch

Koch explains that protectionism can threaten the world trade and he says that it is harmful to have production and consumption at the same place since it means that the meaning of trade is lost. He says that it might seem beneficial in the short term to have production close. However, in the long term when every country starts to think about themselves, there is a risk that the world will be broken into three big blocks of trade. Having three blocks of trade could result in an uneven trading regime with highly unpredictable trade rules and regulations (Tirkey, 2020). Koch urges that the world's leaders need to realize that protectionism will aggravate and stresses that the world must unite and keep trade open and common.

Koch also mentions that it is problematic to use the trade balance as an argument to move production home, in the way President Trump does. Alvstam explains that it is easy to connect national identity and pride with the trade balance, which is what the current president has done. President Trump believes that if the U.S. has a trade deficit, someone is deceiving them, he says. However, a trade balance depends on a lot of other factors, such as savings and investments in relation to consumption, says Alvstam. If the trade policy in the spirit of 'make America great again' is used, it will be problematic, he concludes.

However, it is also of interest to move LIB cell production closer to the final assembly of the vehicle and to not be dependent on one or few single countries. In a world that gets more protectionist, Silfvenius explains that it can be strategically important to move production closer since dependency on other countries means facing a risk of not being able to secure components. Malmström says that it is always good to not be completely dependent on a single source when it comes to sensitive and important components.

Several respondents pointed out that the world is becoming increasingly more protectionist. This impacts trade and globalization. Considering the low supply of LIB cells, countries are in greater need of securing the supply and not depending on other countries, particularly important for the U.S. where protectionism is apparent today.

4.1.9. Presidential Impact

Overall, there was a topic of discussion and a concern regarding the impact of the current president and how the future elections will impact USMCA and other regulations. However, Miller explains that a new administration will not change anything when it comes to RVC requirements. He says that the current administration is very keen on incentivizing production in the U.S., so they are doing everything they can to try to push that even if they lose the election this fall.

"The new rules that we are going to get are not going to change even if there is a new administration, because it was negotiated between the three countries. So, it will be more North American content."
– Miller

Alvstam also agrees that the next election will not result in changes in terms of USMCA. The industry will have to adjust to a higher degree of RVC requirements, he says. Berglund also states that it seems unlikely that a new president would renegotiate the trade agreement.

Moreover, another topic of discussion is how the current president impacts and determines the environmental regulations. Malmström stresses that the president has a lot of power in these issues. President Trump has, for instance, revoked CO_2 emission regulations and the Paris Agreement. However, Malmström believes that if a new democratic president is elected, these regulations will be stricter again. Varney also hopes succeeding presidents will be a bit more environmental-friendly.

The president of the U.S. has a great impact both in terms of trade and environmental regulations. The president plays an important role in the shift toward electrification. The respondents discuss the potential changes with a new president in the future and that a new president can impact the shift in several directions.

4.2. DEVELOPMENT FACTORS WITHIN MARKET DEVELOPMENT

Within the area of market development, twelve development factors have been identified. These are Cell Manufacturing in the ROW, Cell Manufacturing in the U.S., Demand in the U.S., Charging Infrastructure, LIB Cell Ecosystem, Collaborations with Cell Manufacturers, Cells as Core Business, Making Modules and Packs, Competition within the Automotive Industry, Competition within Cell Manufacturing, Human Capital, and Bargaining Power.

4.2.1. Cell Manufacturing in the ROW

The respondents state that cell manufacturing needs to increase everywhere globally. Respondent A means that to meet demand in the future cell manufacturing needs to grow by 20-30 times. China has a lot of plans for development going forward, he continues, as well as South Korea and Japan. Ledung confirms this and explains that many manufacturers chose to initiate cell manufacturing in China due to cost advantages. Moreover, because of protectionism, China puts high pressures on producing components locally, pointing at local cell manufacturing being highly necessary, he says.

Some respondents mention that Europe also has a lot of initiatives and Respondent A believes Europe to be the next big place for cell manufacturing. The EV market is explained to no longer be in the position on the diffusion curve of early adopters (European Battery Alliance, 2020a). Ledung describes that in Europe, the automotive industry is essential for several countries, related to a substantial part of GDP, and therefore, this question is of high interest for many European actors. Normark explains that there are approximately fifteen facilities in Europe either on its way or already fully up and running. Respondent A describes that it is motivated by financial instruments and governmental incentives, such as CO_2 emission regulations. Moreover, the EU formed the European Battery Alliance (EBA) in 2017. Respondent A explains that the EBA has involvement from many actors. Several industries find it of great importance that Europe initiates LIB manufacturing and that the involved actors meet regularly and form strategies in this matter, he continues. Normark describes the first cell manufacturer in Europe was Northvolt and it has become known as the 'European initiative'. However, after Northvolt set up European cell manufacturing, Asian players, e.g. Samsung, LG Chem, and CATL initiated cell manufacturing in Europe as well, he continues. According to Normark, the first realization was that to enhance the competitive landscape for batteries, Europe needs to initiate local cell manufacturing. It is necessary to establish a complete supply chain for batteries in Europe, including manufacturing facilities, to enable securing the paradigm shift that electrification represents (Northvolt, 2019). Moreover, relying on existing Asian cell manufacturers does not work, as dependency on these firms reduces the self-sufficiency of European industries that in the future will rely on batteries (Northvolt, 2019).

Because of these initiatives, Europe is projected to outrun the U.S. in terms of cell manufacturing (European Battery Alliance, 2020a). In 2030, Europe is looking to have a market share of 20-25% of global cell manufacturing, which is a great increase compared to a zero percent market share in 2016, Normark states. In 2019 Europe had a market share of 6% whilst North America had 10% (European Battery Alliance, 2020a). The North American market share was, according to Normark, completely because of Tesla. Moreover, in 2029 Europe is forecasted to have a market share of 18% whilst the U.S. has dropped to 9% (European Battery Alliance, 2020a). An important noting, however, is that China today has 73% of global market share and Asia 11% (European Battery Alliance, 2020a). In 2029, China will still be the largest manufacturer with a market share of 69%, however, Asia's market share is merely 3.5% (European Battery Alliance, 2020a). Importantly, however, Normark adds, Europe will be the second biggest producer in 2029.

Since cell manufacturing needs to increase globally, this subject was discussed widely by the majority of the respondents. Asia is the leading producer and is forecasted to continue maintaining a majority of global market share. Europe has taken a lot of initiatives based upon government regulations favoring sustainable solutions resulting in Europe to slowly catch up with Asia. The U.S., however, does not have the same trajectory, instead, the American market share of global cell manufacturing is projected to decrease.

4.2.2. Cell Manufacturing in the U.S.

During the interviews, it has emerged that future cell manufacturing in the U.S. is highly ambiguous. There is an overall opinion that cell manufacturing will take place in the U.S., however, the respondents agree with it to occur at a slow pace. Moreover, the respondents share the view on the country not having the same pressures to set up cell manufacturing. However, the respondents show an ambiguous view of if and when it will happen.

On one hand, the respondents discuss the risks of setting up production facilities in the U.S., and they are somewhat associated with President Trump. Varney argues that if an Asian firm wants to put a production facility in the U.S., they are taking a gamble because of the unpredictability of what decisions President Trump might take. Moreover, she states that Asian firms are risk averse, so unless they have government incentives to invest in the U.S. or guaranteed contracts from OEMs, they are not going to invest. Both Malmström and Koch state that the Trump administration is highly unpredictable and Normark stresses that the unreliability from the president harms investment propensity. Ledung says that this implies that the U.S. is not where the focus is right now. As long as there is unpredictability in terms of the political situation, investment plans will be pushed forward, he says. According to Berglund, the last thing firms want is unpredictability.

"The president of the United States does not only revoke environmental regulations and policies, but he also creates great unpredictability for firms and customers." – Normark

However, on the other hand, the respondents still believe there will be more cell production in the U.S. in the future. Ledung and Larsson claim the LIB cell market to be profitable and the growth rate will continue to be high. Whittingham says that cell manufacturing will happen in the U.S., probably within three years. Respondent A, however, states that the U.S. is a lot slower on building cell manufacturing facilities, and even though they have a number of facilities and plan on building more, it is not on the same level as in the other countries. Normark confirms this and it is moreover stated in European Battery Alliance's (2020a) forecasts. Groot believes cell manufacturing will be positioned where the OEMs produce vehicles. Normark and Berglund state that cell manufacturing will be needed domestically as a close connection to customers is beneficial. Ledung agrees and states that for OEMs to gain insights into the LIB technology, close proximity to cell manufacturing is necessary. Also, it is easier to collaborate with someone localized nearby than on the other side of the world, he says. Varney, however, says that cell manufacturers will never domestically make all configurations because the domestic demand for it is too low for it to be profitable.

"To gain access to the LIB technology, local manufacturing is necessary." – Ledung

Lastly, it has emerged through the interviews that it is highly unknown what factors will affect the increase in cell manufacturing facilities. Grauers believes that alongside an increase in demand in the U.S., Asian firms will manufacture cells in the U.S. Building upon this, Respondent A believes financial instruments and governmental regulations will be necessary. Additionally, one important aspect is the classification of batteries as hazardous materials, pointing at an aversion toward transporting them across the world for safety and transportation costs reasons, says Grauers. However, Abdellaoui mentions that cell manufacturing in the U.S. still requires importing raw material. Varney points out that transporting these minerals to the U.S., which also are classified as hazardous materials, is not the safest thing to either, nor is it good for the environment. Lastly, one important note that Respondent A mentions is that it takes a long time for a cell manufacturing facility to be fully up and running. When Northvolt initiated its facility in Sweden, it took 6 years, and that was, according to Ledung, considered extremely fast.

Building upon the conclusion in the previous development factor, the respondents discuss why cell manufacturing in the U.S. has a slower growth rate than the rest of the world. This has a lot to do with the unpredictability related to the current administration restraining foreign investments. Also, as the low demand for EVs in the country has a direct effect on cell manufacturing. Furthermore, even if there is an urgency in increasing cell manufacturing, it is a long process going from initiating manufacturing to selling cells.

4.2.3. Demand in the U.S.

Many respondents mention that there is a relatively low demand for EVs in the U.S. Varney believes demand likely, and unfortunately, will remain at the same level as today in the near future. Abdellaoui thinks that a shift toward electrification and sustainable solutions, in general, require both legislative changes from the government and a shift in mindset. The latter is likely going to take a little longer, he says. Silfvenius builds upon this and mentions that demand in the U.S. is driven by 'bang for the buck' and lifestyle. Also, according to Silfvenius and Kellström customers do not buy an EV if it is not economically advantageous. Another important factor is the demand for vehicles in general. According to Gillman, the demand for vehicles has stagnated. The demand for vehicles is impacted by the economic situation says Koch, and in a recession, the demand decreases.

"Because they are rather expensive, it all depends on public policy and what the government decides." – Whittingham

Whittingham says that the demand for EVs is entirely depending on the government. When there is a lack of governmental financial instruments, the demand for EVs is driven by other factors, says Silfvenius. For instance, the total cost of ownership is the main driver of EV adoption (PWC, 2019). Abdellaoui agrees and states that changes in demand can never be predicted. According to Kellström, OEMs make sales forecasts for the forthcoming ten years. They claim to know how the sales volumes will look, the ICEVs are easy to estimate because they know what factors affect the sales volumes and how, but that is not the case with the EVs. The EVs propose difficulties to the forecasts because they are highly unreliable, mainly due to the early diffusion stage and the novelty of the product, Kellström says.

"An EV still is a high investment cost for customers, and there is a need for governmental subsidies to incentivize the customer." – Kellström

All aspects considered, the respondents still think there is a future for the EV in the U.S. Kellström means that even though the environmental restrictions and regulations fail on the federal level, the demand for EVs will still increase. Today, the domestic demand is rather high with specific firms acting as pioneers wanting sustainable solutions, he says. According to Whittingham, eventually, cities will ban ICEVs and he believes it will happen fairly quickly. Gillman describes the growth rate for EVs to be modest in comparison to other countries. Both Normark and Respondent A, however, state that the pace of the shift toward electrification is underestimated. Also, Grauers says that the automotive industry overestimates the problems associated with the shift toward electrification. Normark mentions that it is important to consider that the turnover rate is approximately half compared to a passenger car, and, therefore, the sales volumes are difficult to foresee. Moreover, Balakrishnan explains that in 2025, the ICEVs will have met its maximum emission reduction and, thus, not be able to meet stricter CO_2 emission regulations, and therefore, the shift toward electrification is necessary. Also, alongside a decrease in prices, the American customers will naturally buy EVs if the prices are low and the cost of driving is lower than for an ICEV, says Kellström.

All respondents agree upon the demand in the U.S. is lower compared to the rest of the world. Further, EVs are still in the early diffusion phase, making it hard for OEMs to forecast demand. As discussed throughout this section, there are several factors affecting demand. This makes it difficult for OEMs to strategically plan for its shift toward electrification.

4.2.4. Charging Infrastructure

Another central issue brought up in the interviews is the charging infrastructure. Grauers mentions that OEMs need to assure the existence of a sufficient charging infrastructure. Kellström believes that OEMs have underestimated the development of charging infrastructure. OEMs have assumed that chargers will be available when EVs are launched, but this might not be the case, he says. Grauers, on the other hand, does not believe infrastructure to be a hinder but he thinks it will be available for all types of EVs. In three to four years, the charging infrastructure will be sufficient, he continues. Normark agrees and does not believe the charging infrastructure to be the problem but, instead, that the development of it can be fast. According to Larsson, the issue of infrastructure is investment costs. Grauers, therefore, explain a need for a public charging network. Gillman explains that in the U.S., Tesla has driven the development of charging infrastructure, but those chargers are only compatible with Tesla vehicles. Therefore, other firms are investing in the infrastructure as well, she says. Gillman also mentions that many cities are developing a charging network as well, mostly to enable electric buses.

The development of the charging infrastructure is closely related to the demand for EVs. Without a sufficient charging network, EVs will not function nor be attractive for customers, however, the respondents believe that there are no indications of an insufficient scale-up in infrastructure.

4.2.5. LIB Cell Ecosystem

The respondents mention a need for the entire ecosystem to develop simultaneously. Respondent A states that the constraints in the industry do not depend on cell manufacturers but instead the manufacturers of the components for the cells. Normark points out that everything needs to function along the entire supply chain. He mentions, for instance, refineries, mining of minerals, and recycling of batteries, and this puts constraints on the industry. Ledung also mentions that this is what makes the development of cell manufacturing critical. He says that even if the technological development of the LIB cell occurs, other factors will hinder the development. He mentions, for instance, a need for mining firms, manufacturers of anode and cathode material, investments in research and development, and the production site itself. Ledung describes this to be the purpose of the EBA, that every part of the supply chain is involved to prevent bottlenecks to occur. The challenge for the battery industry is multi-dimensional and should be addressed simultaneously as they are interlinked (European Battery Alliance, 2020b). The mission of the EBA is to ensure a sufficient and unbroken supply chain in Europe to supply the region with batteries (European Battery Alliance, 2020b).

"There is no single player who can drive this change themselves. Customers and other actors need to be in on the journey. It is important to get a common view on where the future is heading and for everyone to play their part" – Respondent A

Moreover, according to Grauers, OEMs cannot stay as closed and non-transparent as they have before, they need to open up and communicate more freely. Moreover, Silfvenius describes that there is a lack of standards for EVs, causing the OEMs themselves to set their own standards which will not be sufficient in the long run.

For the shift toward electrification to occur, there is a need for a simultaneous scale-up in the entire ecosystem. Cell manufacturing is not the only constraint and for the shift to take off all involved parties need to play its part. It is not sufficient for one party to drive the shift.

4.2.6. Collaborations with Cell Manufacturers

One central topic brought up by a majority of the respondents is that OEMs are creating joint ventures with cell manufacturers. There are numerous examples of this. Toyota and Japanese cell manufacturer Panasonic announced the forming of a joint venture in February 2020 (LeBeau, 2020). General Motors together with South Korean LG Chem are also jointly building a LIB cell facility in the U.S., and according to General Motors, this results in a unique combination of advanced technology, scale, and flexibility (LeBeau, 2020). Moreover, the Swedish LIB cell manufacturer Northvolt, earlier referred to as 'the European Initiative', has together with Volkswagen in a joint venture started to build its second LIB cell facility Northvolt Zwei in Germany (Northvolt, 2019). This facility will produce LIBs exclusively for Volkswagen.

Groot argues that because of increased volumes, many OEMs have started to use special cell formats for their vehicles, pointing at a need for close collaboration with a cell manufacturer. The majority of the respondents agree that it will be beneficial to involve in a joint venture, either a cell manufacturer or another OEM to increase volume. Ledung says that OEMs have realized the importance of networking with other actors and that there are interdependencies along the entire supply chain. Normark means that through joint ventures with cell manufacturers OEMs can acquire knowledge. Moreover, by co-investing, the OEM can cut costs and lead time and reduce risk, says Groot. Gillman also believes joint ventures can be the way for OEMs going forward. Grauers says that it is very important for OEMs to have strategies for how to ensure a relationship with cell manufacturers well in advance. Ledung says that OEMs need a long-term business-to-business relationship with a cell manufacturer where they can co-develop the cell technology with the vehicles. If OEMs want to be at the forefront, they need to join in the development of the cell technology, he says.

"I believe very much in close collaboration and building strategies together with their suppliers"
– Grauers

Waiting for cell manufacturers to develop and try out a new cell technology takes time, says Groot, and OEMs cannot afford to lose time. Groot and Ledung discuss that working closer to the cell manufacturer minimizes the time to market. Moreover, the respondents state that cell manufacturers will benefit from close collaboration with an OEM as well. Therefore, Grauers means, cell manufacturers will prioritize this collaboration. Normark also describe cell manufacturers to be interested in interacting with OEMs and to develop the technology collectively. Abdellaoui agrees and says that cell manufacturers will benefit from OEMs' know-how and technical competencies about the automotive industry. Moreover, Grauers states that it has historically been proven that cell manufacturers do not understand enough about vehicles, meaning that they cannot ensure correct optimization and compromise of the LIB cells. This also enhances the importance of OEMs and cell manufacturers to co-develop the technology. However, this means that an OEM needs to assure that they are an interesting partner to the cell manufacturer, Grauers points out. For instance, they can point out that they enable shortening the time to market for the cell manufacturers, as well as testing the cells from a demanding customer point of view.

In general, the respondents do not value the risks for OEMs to involve in joint ventures that high. Normark describes that joint ventures have proven highly efficient historically when looking at other technological improvements. The risks that exist are by Balakrishnan explained to be market and business-related. Both Balakrishnan and Groot describe that it is a risk of being dependent on one supplier, and relying on only one source of batteries is not beneficial for OEMs.

"The larger volumes you have, the more essential it is to be involved in the supply chain" – Groot

Lastly, if an OEM, however, requires LIB cells corresponding to an entire cell production line, then the cell manufacturer might as well build a facility fully dedicated to the OEM, says Groot. Also, if the volumes cover an entire production line, the supplier can just as well customize the format, he says. According to Groot, more and more OEMs are doing this. Also, Normark means that cell manufacturers will make the LIB cells that OEMs want because they are a valuable customer. On the contrary, Groot says that most of the OEMs do not have enough volumes to push a cell manufacturer to initiate a new manufacturing facility. Therefore, he says, OEMs can buy a part of a line or jointly invest in a facility with other OEMs. Kellström also believes there to be potential synergies between OEMs. Miller, however, is critical toward if a joint venture with another OEM will work in practice.

Relationships between OEMs and cell manufacturers exist today. Based on the importance of the LIB cell, OEMs find it increasingly important to engage in the manufacturing of the cells. The respondents argue that collaborations between OEMs and cell manufacturers will continue.

4.2.7. Cells as Core Business

Another topic frequently mentioned by the respondents is if OEMs should make the LIB cells internally themselves. Several respondents discussed whether the LIB cell technology should be viewed as core business, especially in the future. As explained earlier, the traditional way of working for OEMs is not sufficient because they do not retain their bargaining power when shifting toward electrification. The traditional business model will therefore not work forever, says Respondent A. Silfvenius explains that if OEMs keep working the way they are, keeping their departments decentralized and fragmented, they have an economic system that counteracts the shift toward electrification. Instead, they should view their firm in a holistic way, he says, and only then the shift toward electrification will make sense and be entirely profitable. But that involves changing the traditional business model, he concludes.

"The business model is the greatest, long-term problem for OEMs today" – Silfvenius

Respondent A builds upon this and claims that since the value in EVs, in the long run, will be the LIB cell, and OEMs need insights into the cells to be competitive, he says. That means that OEMs need to have cell technology as one of their core businesses, he continues. In the long run, there is a strategic importance of manufacturing the cells in-house, he states, and that is how he thinks OEMs will work in the future. According to a report by Roland Berger (2018), establishing in-house production of LIB cells is one preferable solution to overcome dependency on cell manufacturers. According to Davies (2019), Volkswagen has initiated its own cell manufacturing facility and will hence make the cells, modules, and packs in-house to secure its supply of batteries.

"Up until now, no OEM has had electromobility as a core business. That is the difference between Tesla and the traditional OEMs. Tesla does not exist without its batteries, but the other ones do."
– Respondent A

Tesla is discussed by many respondents. Tesla is highly vertically integrated, producing the majority of its own batteries and controlling the supply chain (Kim, 2019). According to LeBeau (2020), the traditional OEMs used to see Tesla as a startup that did not affect the automotive industry with its competitiveness, nowadays, however, the OEMs pay a lot of respect toward the achievements of Tesla. Tesla as a pioneer in the EV industry and several respondents argue that OEMs should transform their business models more toward the business model of Tesla. Respondent A says that Tesla always has done a lot in-house and that they have a high level of control. Normark says that Tesla provides a competitive advantage through vertical integration by possessing all knowledge and know-how in-house. Normark says that OEMs have to work along the entire supply chain because there are enormous benefits to gain. Therefore, he says, if not creating alliances along the supply chain, doing it themselves is key. Whittingham believes that OEMs will start producing cells internally in the future and that there are rumors that a few OEMs already has started. Varney agrees and says that OEMs have started to evaluate if they should make the LIB cells themselves. The problem is, she says, that due to high investment costs and economies of scale, OEMs would want just one site globally. That implies that the RVC requirements in USMCA are not going to be met anyway if the site is placed outside of the U.S., she continues. Larsson also believes that investment costs are too high for OEMs to take on cell manufacturing in-house. What is important to consider when sourcing the LIB cell is that a substantial part of the total cost of the vehicle is outside the OEMs control, says Ledung. This means that OEMs will not be stable because they will not have control over the planning horizon and the development of it, he continues.

Ledung mentions that only a few years ago, the OEMs did not see batteries that important and automatically outsourced it. Now, however, it is a different situation, he says. Grauers state that OEMs have realized that if they cannot make their LIB cells in-house, they need to gain a deep knowledge about them.

"The batteries are not something you can buy and put into the vehicle, batteries are part of the vehicle, and you need to co-develop the batteries as a component together with the rest of the vehicle." – Ledung

Ledung describes this choice, how to strategically prepare for the future, and how to prioritize between ICEV and EV production, to be crucial. He says that the most critical factor is uncertainty and he claims market and business-related factors are the source for this, not the technology.

The question of 'make or buy?' was discussed and whether or not OEMs will view the cell as core business. High investment costs and lack of economies of scale are, however, argued to be hinders. The respondents argue for a need for engagement for OEMs in cell manufacturing to increase competitiveness in the future. Many respondents mentioned Tesla and its success through vertical integration and related it to be a possible future success of OEMs.

4.2.8. Making Modules and Packs

Abdellaoui and Grauers brought up that another way to minimize time to market is to create the modules and pack in-house, or reduce the modules entirely and go directly from cell to pack. Balakrishnan points these two options out as increasingly common, and Groot agrees with this. Groot says that either they skip modules or the modules get bigger and bigger. Taking on the module and pack assembly in-house is beneficial as it is a crucial factor for determining the range and charging rate (Küpper et al., 2018). Moreover, it enables OEMs to control the space which is important in terms of vehicle design (Küpper et al., 2018). Groot says that it is a natural step simply to try to integrate and a great way to get rid of passive weight or volume and cost. Doing the modules in-house as soon as possible is essential, says Kellström, because that allows both switching to new cell technology and assuring backward compatibility to become easier. Respondent A agrees and stresses that if the OEM cannot manufacture the LIB cells in-house, they should at least make the pack, which most of the OEMs are doing today. This, he means, to ensure the pack fits well into the vehicle. Normark agrees and states that costs will be lower and energy density higher.

OEMs have already initiated integration of some parts of the supply chain of a LIB cell. The respondents mention that OEMs are increasingly initiating the making of modules and packs in-house. Due to benefits such as simple integration to the vehicle, ease of making adjustments, and losing weight and volume, respondents view this essential for OEMs to produce internally.

4.2.9. Competition within the Automotive Industry

The competitive landscape of the automotive industry has been discussed by several respondents. It is changing and there are more players present in the market. Kellström divides the relevant players in the industry into traditional OEMs and startups and Abdellaoui states that more startups are emerging in the industry. Both Kellström and Abdellaoui explain that the two types of manufacturers have different advantages and that there are different opinions about which are the biggest competitors.

Startups are more agile and faster in recognizing opportunities in the market (Klepper, 2002). The traditional OEMs have both industrial muscles, and a functioning service network, Kellström says. However, traditional OEMs are much slower. Startups can experiment completely with new technology, he continues. He means that the startups play under other rules because they do not have to maintain the business for ICEVs at the same time. However, they have a different financial situation. Also, OEMs possess a great advantage in economies of scale for producing various vehicles, which allows for lower costs. Gillman, however, points out that many OEMs are not competitive with the LIB technology, and therefore she argues that the OEMs need to find other ways to differentiate.

The topic of competition within the automotive industry was discussed in several interviews. There are two types of players, startups and traditional OEMs. They both have advantages. OEMs are not yet familiar with LIB technology but they have benefits such as economies of scale, knowledge industry-specific knowledge as well as engineering knowledge of vehicles. Startups, however, mostly produce batteries themselves and thus they possess a significant advantage in the shift toward EVs.

4.2.10. Competition within Cell Manufacturing

The future competitive landscape in the battery industry was also a frequently mentioned topic. The question arose of whether the automotive industry would be affected if new disrupting cell manufacturers entered the market. Respondent A does not believe the current large cell manufacturers would be irrelevant. However, he does believe that every new firm making cells with sufficient quality and at a good price level will be bought by customers. However, Respondent A does not believe that it will be a large number of manufacturers making cells good enough for the automotive industry as it has high requirements. Instead, he believes it still will be no more than five to ten manufacturers.

"The large cell manufacturers will continue making cells the way they do it today" – Respondent A

Normark also thinks the large cell manufacturers of today will be the ones making the relevant cells in the future as well. More specifically, Respondent A mentions five large cell manufacturers that have gained a strong position on the market; Panasonic, CATL, LG Chem, Samsung, and Lishen. According to Statista (2020b), the five largest cell manufacturers are Panasonic, CATL, BYD, LG Chem, and Samsung. Grauers believes that there will be major technological improvements and possibly a technology disruption. Moreover, he does believe that there will emerge new cell manufacturers. Grauers states that someone will make a meaningful breakthrough in the technology and that there is only a 30% chance that whoever does it is one of the existing manufacturers because it is happening so much research on batteries everywhere today. Åvall describes that research is done in academia, e.g. universities until the product is close to commercialization. However, this process can take a decade or more, he says. Balakrishnan states that cell manufactures have good partnerships with both university and startups within the automotive industry. He says that cell improvements are already made by OEMs in collaboration with universities and startups and will continue to.

There are few large players dominating the LIB cell market today, these are mostly Asian firms. Research on new technologies are not only occurring within these firms, but also at startups, universities, and OEMs. However, the respondents believe that the large cell manufacturers will remain relevant in the future, regardless of new entrants or breakthrough technologies emerging.

4.2.11. Human Capital

The threat toward development in cell manufacturing is knowledge and competence, says Ledung. Normark agrees and says that it is critical with the right competence and that human capital is what limits the development. It is difficult to find and attract the right people with the right competence. Whittingham says that the problem is that no one outside of Asia has the experience for cell manufacturing. It is critical for OEMs shifting toward electrification to train the existing workforce to make cells, he says. As mentioned earlier, Alvstam describes the difficulty of moving competence and that there is inertia, which hinders the initiating of cell manufacturing. The EBA also describes human capital as one essential factor in how Europe can become a leader in cell manufacturing, which hence is applicable to every market (European Battery Alliance, 2020b).

"The greatest threat to profitability within cell manufacturing is human capital, not having the right people knowing what to do. That slows down the development" – Ledung

Several respondents pointed out the lack of human capital is one reason for the slow development in the U.S. Normark stresses that the people with competencies required for this industry do not want to move to the U.S. because of its slow adaptation rate toward cell manufacturing. Respondent A says that in Europe many industries think it is important that cell manufacturing is initiated and that there is enhanced research in human capital and development. Grauers believes that because batteries require a lot of know-how and quality, it is difficult to enter this, quite mature industry. However, he continues, as the industry is developing rapidly it can become easier to enter and gain market share with, for instance, new patents.

The respondents argue for a need of human capital. The LIB cell technology requires human capital and this is discussed to be lacking today. For OEMs to initiate cell manufacturing, acquiring human capital is essential.

4.2.12. Bargaining Power

Who possesses the bargaining power in the automotive industry in terms of LIB cells is a relevant topic and was discussed by several respondents. Normark says that traditionally, OEMs have had the bargaining power, but they do not anymore. Respondent A confirms and explains that traditionally, the automotive industry has worked a lot with purchasing high volumes from suppliers and therefore possessed high bargaining power. Today, it is instead the seller's market and OEMs as buyers do not have the bargaining power anymore, says Normark. Respondent A mentions the existence of power relations in the industry. Furthermore, the few largest cell manufacturers have bargaining power over OEMs, he says. Normark agrees and says that the cell manufacturers hold the bargaining power now and will for the coming years. As the demand is going to increase at a much higher pace than supply, there will be a battle between the actors in the industry, he continues.

"There is great potential for cell manufacturers to have great power, especially now when there is little supply and the growth rate is high" – Respondent A

Larsson agrees and says that cell manufacturers have bargaining power due to the low level of supply in relation to demand. However, on the other hand, he mentions that both the cell manufacturers and the OEMs are interdependent, therefore, who possesses the bargaining power is, in fact, difficult to answer. Instead, he believes one important aspect to be that the outcome is of a win-win character so both cell manufacturers and OEMs benefit from it. Normark mentions that when OEMs invest in joint ventures with cell manufacturers they acquire control and bargaining power as well. Furthermore, Larsson mentions that if technology improvement causes the costs to decrease, the batteries will become cheaper and thus might turn into a common good. Then, he continues, the power balance will shift entirely.

Traditionally, OEMs possess he bargaining power. In the shift toward electrification, other parties are increasingly important in the supply chain, causing a shift in bargaining power. Due to the low supply of LIB cells, cell manufacturers are described to hold the bargaining power today. The respondents argue, however, difficulties in determining the evolvement of the OEMs involvement in the supply chain and thus where the bargaining power will lie in the future.

4.3. DEVELOPMENT FACTORS WITHIN TECHNOLOGY

Within the area of technology, three development factors have been identified. These are Development of LIB, Breakthrough Technology, and Technology Risks.

4.3.1. Development of LIB

According to several respondents, the LIBs of today are the future of EVs. The respondents describe the potential of make the LIB up to twice as good in terms of performance, whilst reducing the price a lot. Normark believes that within five years, costs of LIBs will be cut to half, and performance will increase to at least the double. Grauers also believe that LIBs will dominate the EV market in the forthcoming ten years. He believes that just fine-tuning by engineers could improve the performance by up to 30%. Åvall agrees and states that OEMs could increase performance in the near future with engineering, meaning they do not change the chemistry but improves the performance.

"Lithium-ion batteries will persist, there is no indication of anything else" – Normark

Whittingham explains that the basic chemistry has not changed since 1991 and he has a hard time seeing how any other technology could displace it. Åvall, however, believes the chemistry might change in the future since many of the components in LIB are hazardous and rare. Moreover, cobalt is highly criticized in terms of ethical sustainability and the use of child labor (Sanderson, 2019). However, Åvall is convinced that the LIB will be the technology used for decades in EVs, and he claims that investing in LIB technology is the way to go for OEMs.

”For electric vehicles, lithium-ion batteries is the only way to go, it has got the highest energy density.”
– Whittingham

Normark agrees that, within the next few years, a revolution of the LIB will not happen. Instead, he believes the existing batteries will develop and get better. Abdellaoui explains that historically in the industry it has been a breakthrough in LIB improvement approximately every two years, but now he thinks the breakthroughs will stagnate. Groot agrees explaining that the improvements will take smaller and smaller steps. However, he says, technology benefits will come from the cost side instead, and he notices potential in optimizing the packs, modules or systems.

Whittingham stresses the difficulties for heavy-duty trucks with today's batteries and says it will be challenging to go long distances since the weight of the batteries will be too heavy. Balakrishnan agrees and stresses that for heavy trucks he is skeptic due to the weight of the batteries and he can only see the potential with LIB in light and medium duties. Moreover, Grauers mentions that there is a huge technological challenge with making the LIB lighter. Respondent A also states that the size of CVs might be an issue since it is more difficult to electrify larger vehicles.

There are still opportunities for improvements in the LIB cell. Respondents argue that the LIB cells have the possibilities of the performance becoming twice as good and prices being cut to half. The continuous development of the LIB cell is agreed upon, thus minimizing the concerns for OEMs of investing in technology becoming obsolete.

4.3.2. Breakthrough Technology

Many respondents mentioned the possibility of new technology replacing the LIB. Respondent A mentions risk management to be necessary for OEMs because of the possibility for breakthroughs in cell chemistry. Important to bear in mind is that new breakthrough technologies take time to develop. According to Grauers, it takes over ten years to develop new technology, however, he says, someone can already have spent four or five of those years. One new technology mentioned by several respondents is solid-state battery cells which seems to be the next breakthrough. The new technology involves a change from a liquid electrolyte to solid-state. However, even though the chemistry is different, Whittingham points out that the batteries are still classified as lithium-ion battery.

The respondents have different views on when the solid-state battery will enter the market. Both Respondent A and Varney believe that cell technology is going to rapidly develop and change over the next five years. However, the majority of respondents believe it will take more than five years for a breakthrough technology to occur, especially for the automotive industry. Abdellaoui stresses that a common projection of when a breakthrough within LIB technology will happen is 2027. Groot explains that if solid-state enters the market, it will take at least ten years. He stresses that the solid-state cells will be used a lot in smaller applications before they will reach the automotive industry. Tintignac confirms and states that it is realistic with, for example, solid-state in 2025, however, not for the automotive industry. Larsson confirms and explains that it will take a couple of years more before they can produce large-scale. Ledung also stresses that new technologies are always costly in the beginning, meaning that great cost advantages will be possessed even later on.

Above all, there is an agreement on a new technology taking a very long time to reach large-scale production and become useful for the automotive industry. Ledung stresses that OEMs cannot wait for a new technology to break through, they to get going now, which is confirmed by Balakrishnan.

Even though research around new technologies replacing the LIB occurs, respondents do not find this a big threat for LIB cell technology. It takes time for a technology to become good enough and commercialized, especially in the application of EVs. This means that new technology arising is not a threat in the near future for OEMs.

4.3.3. Technology Risks

The biggest risk for OEMs mentioned by many respondents is the changes in technology and breakthrough innovations. Grauers says that it is not difficult to change the LIB cell if the technology changes, the highest impact will be if the size of the pack changes. Balakrishnan explains that the risk is not about technological development, because the OEM can swap the cells if the chemistry changes. The big risk is when the format changes, he says. It is not possible to swap quickly if there are different dimensions of the packs or the assembly, says Groot. Also, OEMs want to lock the dimensions as early as possible and keep a specific format for as long as possible which generates a risk, he continues. The big challenge with changes in battery chemistry, performance, the module, pack, or type of cell is to get the battery backward compatible. Building upon this, Groot and Kellström mention that OEMs require stability, access to spare parts, and the ability to provide after-market service for vehicles for up to twelve years. For that reason, they cannot change too often and quickly either, Groot explains. Kellström says that it is important to keep flexibility whilst being price competitive.

"At a best-case scenario, it is only a new battery system that has exactly the same dimensions where there is only one software update on the vehicle so the vehicle understands that it is a new battery. In the worst case, it is a rebuilt battery or a new adapter kit" – Groot

Both Groot and Kellström mention the benefits of signing long-term agreements to reduce prices. However, Kellström describes the risk of signing long-term contracts in the case of a breakthrough, thus, being stuck with obsolete technology. Several respondents state that they are not particularly worried about OEMs' vulnerability in case of new breakthrough technology. Normark states that if a new technology enters, the old ones would not disappear.

"All batteries ever invented are still being manufactured." – Normark

The biggest change will for cell manufacturers to change their facilities, says Grauers. According to Grauers, one third of the cell manufacturers will not make it through a technological breakthrough because of faulty strategic actions. Åvall, however, explains that solid-state is so similar to the LIB that the cell manufacturers could have switched to their current production. Normark agrees, saying that the cell manufacturers only need to adjust about 10-15% of its current machinery. Another challenge mentioned is not knowing how other technologies will affect the industry, Ledung says. The picture might look totally different if there only were autonomous vehicles driving the load, which might result in that vehicles have completely other requirements on weight and distances, he continues.

”If we look with today's glasses it might not be fair for what technology can contribute with in the future. The future looks different.” – Ledung

There are great technology risks related to the shift toward electrification. OEMs need to adjust their vehicles to the size and format of the LIB and as size and formats often change and improve, it is beneficial if OEMs are flexible. However, being flexible is difficult and costly, implying difficulties and risks in choosing and sticking to a specific LIB cell.

5. SCENARIO PLANNING

This section includes conducting the five steps of the customized scenario planning framework. Four scenarios are built answering how the market for EVs can develop in the U.S., what role OEMs can have in each scenario, and what OEMs involvement in the LIB cell supply chain can be. More specifically, the scenario planning process enables answering what sourcing mode for lithium-ion battery cells original equipment manufacturers can take to meet future demand in the United States.

5.1. STEP 1 - DEFINING THE SCOPE

Defining the scope is the initial step of the scenario planning framework. It involves the important stages of setting the scope for the scenario planning and aligning the goals and purpose with the stakeholders. The important aspects of defining the scope are summarized in a framing checklist, shown in *Figure 5.1*.

The purpose of scenario planning was set in collaboration with the partner company. Due to mainly three reasons, OEMs experience difficulties in planning their future sourcing mode for LIB cells in the U.S. These reasons are covered in the research areas of investigation: politics and trade, market development, and technology. The goal of scenario planning is to identify future trends and uncertainties affecting the most suitable sourcing mode for OEMs operating in the U.S. These trends and uncertainties enable mapping out four future scenarios. This will, in turn, guide OEMs in planning their future sourcing strategies for LIB cells in the country.

To reach the goal, the strategic level of analysis focuses on the perspective of OEMs within the automotive industry present in the American market. Furthermore, by taking the theoretical viewpoint of sourcing models, the scenario planning process generates an overall assessment of possible ways to source LIB cells in different future scenarios.

As stressed in the literature review, it is important to include various stakeholders in order to widen the views of future outcomes and create greater reliability of the process. In this case, the main stakeholders are broadened to both include OEMs and academia. Hence, this research involves two separate views where the researchers are intermediaries connecting industry changes to academic research.

When predicting changes in the industry, a long enough time-frame must be used. A short time-frame risks missing central trends with a long-term impact (Lindgren & Bandhold, 2003). Big changes in the shift toward electrification are not likely to occur in the next couple of years, making a longer time-frame necessary. Moreover, as stated earlier, cell manufacturing facilities take several years to be up and running, also pointing at a need for a longer time-frame. However, the further ahead into the future the research aims to investigate, the greater the possibilities and the less relevant the planning becomes (Lindgren & Bandhold, 2003). To set a reasonable time-frame this was elaborated with the partner company who highlighted a forecasting time-frame of ten years to be sufficient and common in the automotive industry. Hence, the time-frame has been set to ten years. This allows the scenario planning to be in line with concerns of existing literature as well as in line with forecasts within the industry.

Lastly, the participants of the scenario planning are defined to be experts within the three areas of investigation: politics and trade, market development, and technology, where each respondent's expertise relates to one of these three areas.

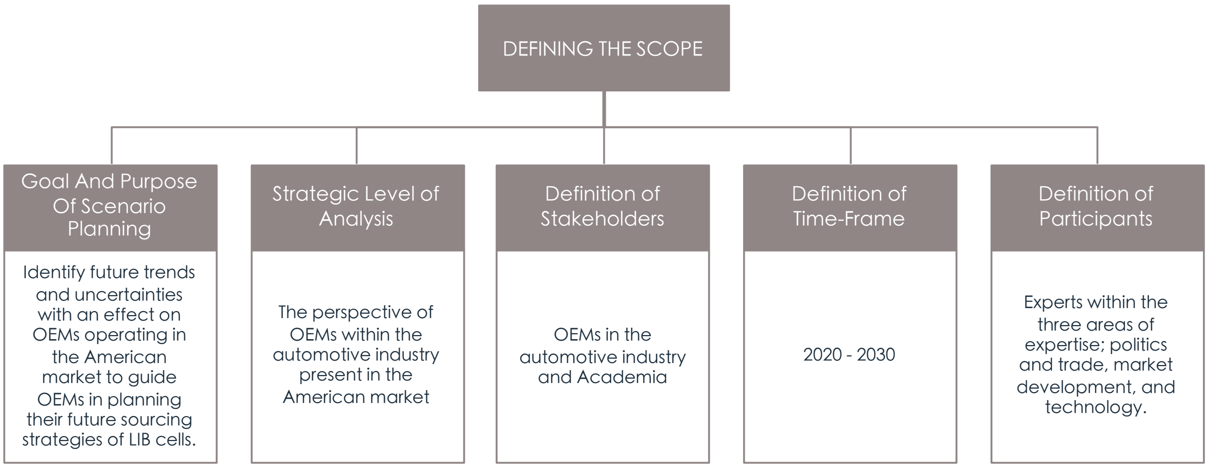

Figure 5.1. Framing Checklist Summarizing the Definition of the Scope.

5.2. STEP 2 - TREND AND UNCERTAINTY ANALYSIS

The second step in the customized scenario planning is the trend and uncertainty analysis. This step allows for identification of trends and uncertainties from the identified development factors in the previous section. As explained previously, the customized framework allows for a joint analysis of trends and uncertainties within the three areas of investigation.

Four predetermined inclusion criteria are taken into consideration when determining if a development factor qualifies for a trend or an uncertainty. Not all identified development factors are of relevance for the scenario building, therefore, for a factor to be classified as a trend or an uncertainty, all four criteria need to be fulfilled. The three first criteria are equal for both trends and uncertainties. Firstly, the development factor needs to be relevant and effective within the predetermined time-frame of ten years. Secondly, the development factor needs to have a significant impact on OEMs in the automotive industry within this time-frame, meaning that the strategic actions of OEMs present in the U.S. need to be affected by the outcome of the development factor. The third criterion involves the development factor's number of mentions by the respondents. This criterion can be fulfilled in two ways, either 30% of the respondents in an area of investigation mention the development factor, or, 30% of the experts in the area of investigation mention the development factor. Lastly, the fourth criterion varies between trends and uncertainties. For a trend, the outcome of the development factor is certain, hence, agreed upon by the respondents. For an uncertainty, the outcome of the development factor is instead uncertain, hence, the respondents do not agree upon a specific outcome. After determining the trends and uncertainties, they are mapped out in three impact/uncertainty grids respectively to visualize their importance for the scenario building.

The 24 development factors identified in the previous section have been evaluated based upon the predetermined set of criteria. Out of these 24 development factors, nine trends and nine uncertainties emerged. These are moreover categorized and presented below within the three areas of investigation.

5.2.1. Trends and Uncertainties within Politics and Trade

Within the area of politics and trade, there are nine development factors. In *Appendix B*, an illustration of what development factors were mentioned by which respondents is presented. Below in *Table 5.1.*, the criteria are presented to illustrate the determination of which of the nine development factors categorizes as a trend or uncertainty.

Development Factor	Relevant and Effective within the ten-year time-frame	Significant Impact on OEMs in the industry	Mentioned by 30% of the Experts and/or 30% of the Respondents	Certain or Uncertain Outcome?	Trend or Uncertainty?
Environmental Regulations	X	X	X	Uncertain	Uncertainty
Sustainable States	X	X	X	Certain	Trend
USMCA in Force	X	X	X	Certain	Trend
Ratification of USMCA	X	X	X	Certain	Trend
Dysfunctional Judiciary in WTO	X		X	N/A	N/A
Exemptions in USMCA	X		X	N/A	N/A
RVC requirements	X	X	X	Certain	Trend
Protectionism	X	X	X	Certain	Trend
Presidential Impact	X	X	X	Uncertain	Uncertainty

Table 5.1. Trend and Uncertainty Identification within the Area of Politics and Trade.

Out of the nine development factors, five trends and two uncertainties are defined, as presented in *Table 5.1.* The development factors with a certain outcome, i.e. trends, are Sustainable States, USMCA in Force, Ratification of USMCA, RVC Requirements, and Protectionism. The development factors with an uncertain outcome, i.e. uncertainties, are Environmental Regulations and Presidential Impact.

There were two factors that did not meet the criteria of qualifying as a trend or uncertainty for this case. Dysfunctional Judiciary in WTO was one of them, and even though a dysfunctional judiciary system affects the trade in case of conflict between countries, the impact on the OEMs is not affected to that grade that OEMs need to take preconscious actions and plan their future strategies around it. Exemptions in USMCA was also discussed recurrently but as it turned out to not be possible with any exemptions to eliminate the RVC requirements for LIB cells, it does not have an impact on OEMs and is disregarded.

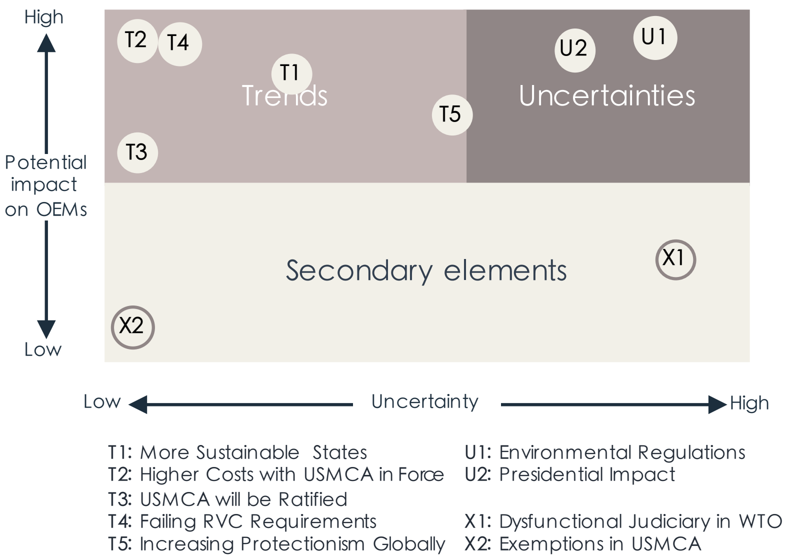

Figure 5.2. Impact/Uncertainty Grid for Politics and Trade.

Figure 5.2. illustrates the potential impact on OEMs within the time-frame of ten years and the level of uncertainty. The trends have a certain outcome whereby they have been renamed accordingly to their outcome. Also, the uncertainties have been given two possible outcomes since the scenarios are based on dichotomous uncertainties. This, since scenario planning is irrelevant when the possible outcomes are many and several possible outcomes often create an overwhelmed feeling (Lindgren & Bandhold 2003; Schoemaker, 1995). Below follows a description of the trends and uncertainties found within politics and trade where the outcome of trends is described as well as the dichotomous outcomes of each uncertainty.

TREND 1 - More Sustainable States

Even though federal incentives encouraging the transition toward EVs are being rolled back by the current administration it exists several state-level initiatives and regulations that encourages the shift to EVs. California is a pioneer with own sustainable initiatives and regulations, and as more and more states follow the Californian initiatives. Hence, it is likely to believe that more states are becoming sustainable resulting in a certain outcome and this trend to be identified. The trend points at more sustainable states will emerge during the time-frame of ten years. If more states follow stricter environmental regulations it would impact the adoption of EVs and thus it has a significant impact on OEMs in the U.S.

TREND 2 - Higher Costs with USMCA in Force

Regarding USMCA in Force a certain outcome could be identified. USMCA will most certainly imply that several OEMs will not comply with the RVC requirements since it does not exist enough cell manufacturing facilities in the U.S. to meet demand. This, in turn, will imply that OEMs will have to take the extra cost when exporting their vehicles from the U.S. to Mexico and Canada. One way to lower the cost could be to take advantage of free trade agreements existing with other countries and at least bring the product into the U.S. duty-free. However, at a certain level of produced volume the tariffs from USMCA will higher to cover and result in a question of competitiveness. The trend identified here is, nonetheless, that USMCA will imply higher costs for OEMs which is something that will impact the industry within the ten-year time-frame and have an effect on OEMs.

TREND 3 - USMCA will be Ratified

Another topic of discussion in relation to the scope where a certain outcome could be identified was whether USMCA would be ratified and if it would be possible to withdraw USMCA. If USMCA could be withdrawn it would mean business as usual in the U.S. in terms of RVC requirements. However, from the data collection it became clear that there are no possibilities of withdrawing USMCA. Also, during the time of the research Canada ratified the agreement which means it will come into force in the near future. Therefore, OEMs will have to readjust to the stricter RVC requirements during the ten-year time frame.

TREND 4 - Failing RVC Requirements will have an Effect on OEMs

Since it is certain that USMCA will be in effect, the effects of the RVC requirements also have a certain outcome. It was identified by most of the respondents that cell manufacturing, in the end, must take place in the U.S. in order for OEMs to stay competitive. Since the cell makes up most of the cost of an EV, the RVC requirements can never be met by importing cells from other countries. As stated above, since most of the OEMs are buying their cells from Asian countries today, the cost of the tariffs will at one point be too big for the OEMs resulting in a loss of competitiveness. Within the ten-year time frame, this naturally has a big impact on how the OEMs plan for their future sourcing of the LIB cell.

TREND 5 - Increasing Protectionism Globally

The respondents pointed toward an unpleasant feeling of the decreasing world trade, yet, the common conclusion of it was that we are heading toward a more protectionist world. This has a great effect on OEMs since it is not beneficial to source the LIB cells from solely one part of the world. The risks with becoming more protectionist and bringing production of LIB cells closer is that costs will increase, and quality will go down, making the trend toward protectionism increasingly important for OEMs.

UNCERTAINTY 1 - Will Environmental Regulations be Enforced?

The fact that the state-level initiatives were pointing toward sustainable regulations is one step that goes in the right direction, however, the environmental regulation on a federal level and the regulation overall in the U.S. is heading in the other direction. There are regulations pointing at ICEVs will remain in the U.S. for a long time, which hinders the adoption of EVs. However, this can change with a new president entering, or other initiatives influencing the federal administration to develop a greener country. The environmental regulations have a high impact on the OEMs since it impacts demand and the shift toward EVs. Since it is not clear in which direction the environmental regulations in the U.S. will continue, this development factor has been identified as an uncertainty with two possible outcomes.

Outcome 1: Environmental regulations will be enforced at a federal level impacting the demand for EVs.
Outcome 2: Environmental regulations will not be enforced at a federal level and will not increase the demand for EVs.

UNCERTAINTY 2 - How will the President Impact the Shift Toward Electrification?

A new president influence both environmental regulations and trade willingness. A likely development can be identified for the nearest four years where it seems like President Trump will retain his position, but after those four years, the outcome is much more uncertain resulting in an identified high uncertainty. Regulations and initiatives have a high impact on OEMs within the time frame and since this can change a lot depending on the presidential election, this factor has been identified as an uncertainty.

Outcome 1: A president gets elected that enforces environmental regulations and financial incentives positively influencing the shift toward electrification.
Outcome 2: A president gets elected that does not enforce environmental regulations nor financial incentives which does not positively influence the shift toward electrification.

5.2.2. Trends and Uncertainties within Market Development

The defined trends and uncertainties within market development are summarized in *Table 5.2.* As in the previous area of investigation, what development factors were mentioned by which respondents is illustrated in *Appendix B*.

Development Factor	Relevant and Effective within the ten-year time-frame	Significant Impact on OEMs in the industry	Mentioned by 30% of the Experts and/or 30% of the Respondents	Certain or Uncertain Outcome?	Trend or Uncertainty?
Cell Manufacturing in the ROW	X	X		N/A	N/A
Cell Manufacturing in the U.S.	X	X	X	Uncertain	Uncertainty
Demand in the U.S.	X	X	X	Uncertain	Uncertainty
Charging Infrastructure	X	X	X	Certain	Trend
LIB Cell Ecosystem	X	X	X	Uncertain	Uncertainty
Collaborations with Cell Manufacturers	X	X	X	Certain	Trend
Cells as Core Business	X	X	X	Uncertain	Trend
Making Modules and Packs	X	X	X	Certain	Trend
Competition within the Automotive Industry	X		X	N/A	N/A
Competition within Cell Manufacturing			X	N/A	N/A
Human Capital	X	X	X	Uncertain	Uncertainty
Bargaining Power	X	X	X	Uncertain	Uncertainty

Table 5.2. Trend and Uncertainty Identification within the Area of Market Development.

There are three development factors within the area of market development that did not fulfill all criteria. Hence these three factors did not qualify to be a trend or an uncertainty. The first one is Cell Manufacturing in the ROW. This factor is effective within the time-frame as the development of cell manufacturing in the world is happening right now. Moreover, it also has a high impact on OEMs in the industry. However, the factor is not discussed by enough respondents. The second factor that did not meet all three criteria is Competition within the Automotive Industry. Competition within the Automotive Industry is perceived to be of relevance within the time-frame, moreover, it is mentioned by a sufficient amount of respondents. However, the impact on the OEMs is not significant as the competitive landscape is not seen to have changed extensively, why this factor does not fulfill the second criterion. The third factor is Competition within Cell Manufacturing. It does not have a significant impact on OEMs in the industry since it was stated that cell manufacturers will continue to be relevant even if new firms enter the market. Moreover, there is nothing pointing at the competitive landscape will change significantly within the time-frame of ten years.

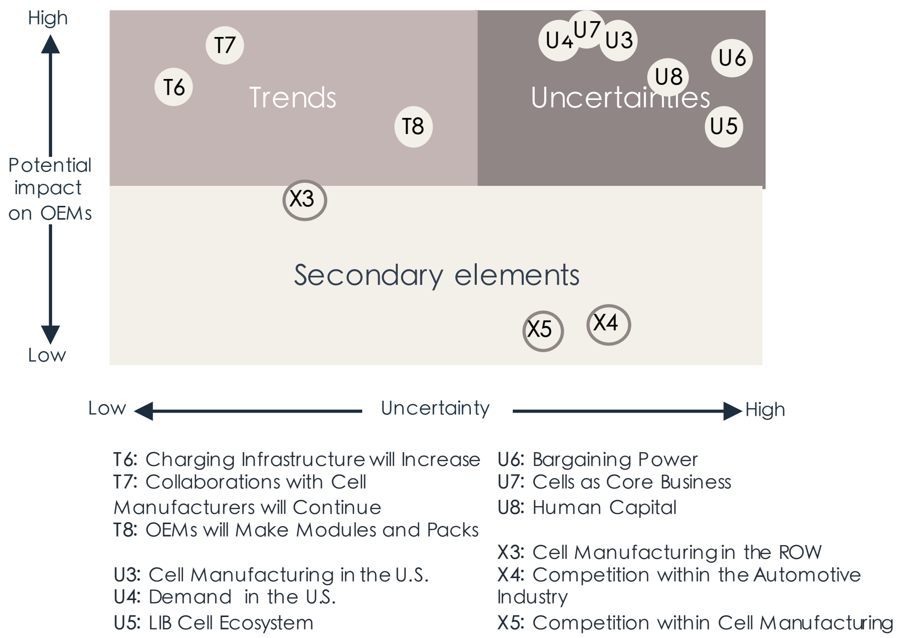

Figure 5.3. Impact/Uncertainty Grid for Market Development.

All development factors have been mapped out accordingly to illustrate the previous categorization. This is illustrated in *Figure 5.3*, where the trends once again are renamed to indicate their outcome. To further explain all trends and uncertainties a description follows below, where the outcome of trends is explained as well as the two possible outcomes of the uncertainties.

TREND 6 - Charging Infrastructure will Increase

Charging infrastructure is naturally a central issue when discussing the evolution of EVs. The majority of the respondents possessing market development as their area of expertise discussed the development of charging infrastructure. Moreover, several respondents do not believe charging infrastructure to hinder the evolution of the EV market, nor cell manufacturing. The respondents describe that both firms and cities are interested in investing in charging networks, even though investment costs are high. The trend points toward a growth in charging infrastructure within the time-frame which thereafter will enable increasing demand for EVs, thus it has an impact on OEMs.

TREND 7 - Collaborations with Cell Manufacturers will Continue Rising

One central trend that has emerged in the automotive industry is OEMs collaborating with cell manufacturers through joint ventures or strategic alliances. The majority of respondents discuss this, and it is confirmed by a vast amount of secondary data resources. This trend has a great impact on the industry as it strengthens the competitiveness of the OEMs participating in this type of collaboration. As is argued by several respondents, joint ventures are of high interest for cell manufacturers as well as they gain insights into the automotive industry. There is an overall opinion that even though it exists risks and disadvantages with establishing a joint venture with one specific cell manufacturer, the advantages are greater and thus OEMs should heavily consider this option.

TREND 8 - OEMs Making Modules and Packs In-house will be More Common

Related to the previous trend is the development factor of OEMs making modules and pack in-house. This factor is brought up by several respondents and due to existing evidence pointing at a certain outcome, this development factor is classified as a trend. This trend provides opportunities for OEMs as it opens up for excluding one party (i.e. module and pack manufacturers) in the supply chain. Another possibility is for OEMs to exclude the module and go directly from cell to pack. This trend reduces costs and complexity in the supply chain and has a significant impact on OEMs.

UNCERTAINTY 3 - Will Cell Manufacturing in the U.S. Increase?

This uncertainty is discussed by the vast majority of the respondents and it is highly relevant for OEMs. As is described earlier, the respondents show an ambiguous view on when the cell manufacturing in the U.S. will increase, pointing at the development factor being of uncertain outcome. The respondents discuss the difficulties for foreign firms of setting up facilities in the U.S. due to unpredictable behavior by the current president. Also, as cell manufacturing require certain raw material not available in the U.S., importing through transportation of these hazardous materials are not optimal, pointing at an averse toward building cell manufacturing facilities in the U.S. However, it is clear that cell manufacturing will increase within the time frame, even if not at the same pace as in the ROW. The question of if it will happen at the required pace to meet future domestic demand or not remains which impacts OEMs significantly.

Outcome 1: Cell manufacturing in the U.S. will increase and meet domestic demand.
Outcome 2: Cell manufacturing in the U.S. will develop according to current forecasts, causing a deficit in domestic supply.

UNCERTAINTY 4 - Will the Demand for EVs in the U.S. Increase?

The respondents have discussed the demand for EVs in the U.S. and more specifically that it is lower than in other countries or regions. However, the respondents have a rather optimistic view on the U.S. development toward sustainable solutions, while forecasts show that demand is lower in the U.S. compared to the ROW. This points at the outcome of the demand for EVs in the U.S. is uncertain. The demand is positioned to have a high impact on OEMs and this factor is also relevant within the time-frame.

Outcome 1: Demand for EVs will increase in the future.
Outcome 2: Demand for EVs will remain relatively low.

UNCERTAINTY 5 - Will there be a Sufficient LIB Cell Ecosystem?

The respondents agree that this factor has a significant impact on the industry, and it is relevant in the ten-year time-frame. However, whether the ecosystem will be sufficient or not is uncertain pointing at the factor being classified as an uncertainty. Many different actors need to join in initiating cell manufacturing, and if this will happen simultaneously or result in various constraints is uncertain. Hence, this factor has two potential outcomes.

Outcome 1: The ecosystem for cell manufacturing will be sufficient.
Outcome 2: The ecosystem for cell manufacturing will not be sufficient.

UNCERTAINTY 6 - Who will Possess the Bargaining Power in the Future?

The importance of LIB cells in the automotive industry has caused power relations to shift. The transition toward electrification involves cell manufacturers entering the automotive industry which tends to shift the bargaining power. As is explained earlier, the OEMs traditionally hold the bargaining power, but this is not the case anymore why this factor is of importance to take into consideration in this research. Bargaining power will be of great significance for OEMs in the future, but the outcome of this factor within the time-frame is still uncertain and is highly dependent on the development of cell manufacturing.

Outcome 1: Cell manufacturers possess bargaining power in the future.
Outcome 2: OEMs possess bargaining power in the future.

UNCERTAINTY 7 - Will OEMs consider the LIB Cell as Core Business?

Closely related to the discussions of joint ventures and close collaboration between OEMs and cell manufacturers is the development factor of if the LIB cell should be viewed as core business by OEMs. Overall, the respondents share the view that OEMs should undertake in-house manufacturing of the LIB cell in the future to gain a competitive advantage. There are several aspects to this question, and all closely related to the transformation toward electrification and the development of LIB cell manufacturing. Respondents describe the problems to be related to the traditional business model, and that OEMs should reshape their business model to electrification accordingly, whereby this factor can be highly impactful for OEMs within the time-frame. Whether OEMs will consider the LIB cell as core business and undertake production in-house is uncertain, thus there is two potential outcomes of this uncertainty.

Outcome 1: OEMs initiate cell manufacturing in-house.
Outcome 2: OEMs will continue to outsource LIB cells.

UNCERTAINTY 8 - Is there a Lack of Human Capital?

The final uncertainty within the area of market development is human capital. Many respondents believe human capital in terms of competence and know-how to be the critical aspects in the development of cell manufacturing and the EV industry. Apart from including high investment costs, cell manufacturing is described to be human-intensive, requiring the right competences. The respondents pointed out, that having cell manufacturing concentrated in Asia results in a lack of sufficient competence and experience outside of Asia which can result in slow development of cell manufacturing in the U.S. This impacts OEMs in the U.S. and it is a highly relevant issue within the time-frame of ten years. Whether it will exist sufficient human capital in the U.S. in the future is uncertain.

Outcome 1: Human capital within the battery industry will increase and meet demand.
Outcome 2: Human capital within the battery industry will remain low causing demand to exceed supply.

5.2.3. Trends and Uncertainties within Technology

Three development factors emerged within technology. These are summarized in *Table 5.3*. Out of them, one factor fulfills all the four criteria and has a certain outcome. This trend is Development of LIB. Moreover, one factor fulfills all criteria but has a more uncertain outcome, this uncertainty is Technology Risks. As for the previous areas of investigation, what development factors were mentioned by which respondents is illustrated in *Appendix B*. Below follows an illustration of the trends and uncertainties identified through the set criteria.

Development Factor	Relevant and Effective within the ten-year time-frame	Significant Impact on OEMs in the industry	Mentioned by 30% of the Experts and/or 30% of the Respondents	Certain or Uncertain Outcome?	Trend or Uncertainty?
Development of LIB	X	X	X	Certain	Trend
Breakthrough Technology		X	X	N/A	N/A
Technology Risks	X	X	X	Uncertain	Uncertainty

Table 5.3. Trend and Uncertainty Identification within the Area of Technology.

The factor Breakthrough Technology did not fulfill all criteria, hence it does not qualify for a trend or an uncertainty. The criterion not fulfilled is the effectiveness within the time-frame. A possible technology breakthrough will have a significant impact on the industry, however, this breakthrough in the automotive industry will not occur in the preset time-frame of ten years. As is explained by the technology experts, the new technology might occur within five to ten years, however, it will take a lot longer before it is available in large-scale for the automotive industry, thus, it is not relevant for the scenario building.

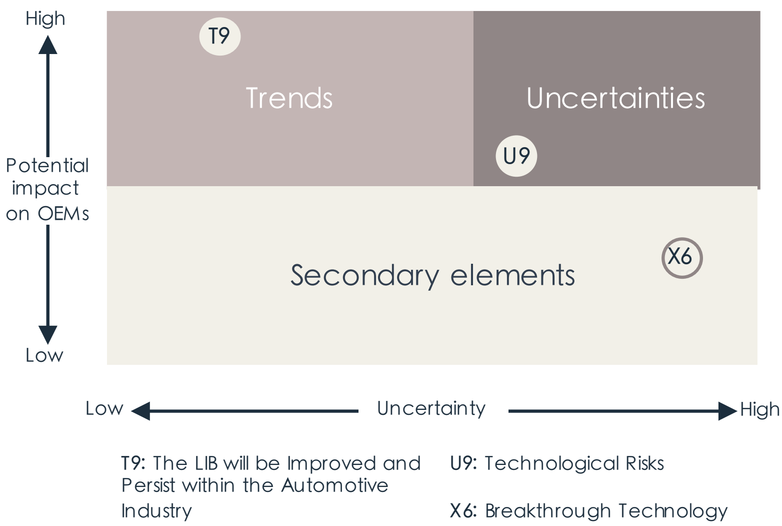

Figure 5.4. Impact/Uncertainty Grid for the Area of Technology.

As illustrated in *Figure 5.4.*, the factors all had different impact on the OEMs as well as different uncertainty. As for the other areas of investigation, the trend has a certain outcome whilst the uncertainty implies two outcomes. To further explain this, the trend and uncertainty are described in further detail below.

TREND 9 - The LIB will be Improved and Persist within the Automotive Industry

A majority of the respondents mention the potential of improving the LIB to become up to twice as good in terms of performance whilst the costs can be cut to half. Some respondents claim that a revolution of the LIB might occur within a few years resulting in these improvements. Even if a revolution does not occur, engineers can fine-tune the LIB cell and make significant improvements. This implies a significant impact on OEMs within the time-frame. Several respondents stated that even though there are discussions of new breakthrough technologies, the LIB will persist and continue to be the primary technology for EVs during the time-frame of ten years. Since there is an overall agreement of the importance and potential improvements of the LIB, this development factor is identified to be a trend.

UNCERTAINTY 9 - How will Technology Risks Develop for OEMs in the Future?

A big risk for OEMs when planning their future sourcing of LIB cells is the changes in technology. Even though a breakthrough technology could not be identified within the time-frame, smaller changes such as size and format of the cell can occur. EVs are produced based on a certain battery format and if technical improvements result in a new format, OEMs face a risk of their vehicles relying on obsolete technology. Even though these risks can be minimized with backward compatible parts, but it is highly unclear how easy this would be in reality. Thus, the technical risks have an uncertain outcome, thus, it is defined as an uncertainty.

Outcome 1: There will be high technology risks for OEMs in the future.
Outcome 2: There will be low technology risks for OEMs in the future.

5.3. STEP 3 - CHECKING FOR PLAUSIBILITY AND CONSISTENCY

This step constitutes of checking for plausibility and consistency among the trends and uncertainties. Firstly, a correlation analysis is made to test if the uncertainties relate to each other or if they are independent. Secondly, a trend impact analysis is presented, describing the impact of each trend on the nine uncertainties as well as on the other trends.

5.3.1. Correlation Analysis

The correlations between the identified uncertainties are summarized in the correlation matrix, see *Table 5.4*. As previously described, the correlations can have a positive correlation (+), a negative correlation (-), a neutral correlation (0), or an unknown correlation (?). In some cases, the correlation can have a correlation in both a positive and a negative direction, meaning that the outcome of one uncertainty can affect another uncertainty in two different outcomes (+/-). The correlations are determined based on the chosen time-frame of ten years. Hence, in a longer time-frame, the correlations might change.

Correlation Matrix									
	U1	U2	U3	U4	U5	U6	U7	U8	U9
U1		+/-	+	+	?	0	0	0	0
U2			?	0	0	0	0	0	0
U3				+	+	?	0	+	?
U4					+	0	+/-	0	0
U5						?	?	+	-
U6							+/-	0	?
U7								?	?
U8									0
U9									

Table 5.4. Correlation Matrix.

In the case where a correlation could be determined, thus the ones marked with (+), (-), or (+/-), the uncertainties are dependent in some way. This is important to take into consideration when building scenarios to ensure the scenarios to be plausible and consistent. A thorough explanation of each correlation will be outlined below as it will be used for building the dimensions as well as the scenarios in the next step. However, for the uncertainties where no dependency could be determined or where dependency was unknown, the plausibility and consistency of the scenarios are not affected. As these are not relevant for the scenarios, the reasoning behind the determinations of neutral (0) and unknown (?) correlations are placed in *Appendix C*.

U1 Environmental Regulations and U2 Presidential Impact (+/-). The first uncertainty is Environmental Regulations and the respondents discuss whether there will be stricter environmental regulations on a federal level in the U.S. in the future. U1 in relation to U2, Presidential Elections, is found to have a correlation in two directions. According to both primary and secondary data, the president is discussed to have a big impact on environmental regulations. A new president of the U.S. can result in either greater environmental regulations or further environmental deregulations. There is a correlation between these two uncertainties, however, it can go in both a positive and negative way why it is marked ‘+/-’.

U1 Environmental Regulations and U3 Cell Manufacturing in the U.S. (+). Whether environmental regulations will have an impact on cell manufacturing in the U.S. is not certain, however, it is estimated by the researchers that the correlation likely will be positive. The reason why cell manufacturing grows at a slower pace in the U.S. might be because there are inadequate environmental regulations. Further, many respondents point out that environmental regulations are one reason why Europe initiated the Battery Alliance. Therefore, enforced environmental regulations in the U.S. will likely have a positive impact on cell manufacturing in the U.S.

U1 Environmental Regulations and U4 Demand in the U.S. (+). The uncertainty of environmental regulations will have a positive impact on the demand for EVs in the U.S. A majority of the respondents points out that the low demand in the U.S. depends on a lack of environmental regulations and financial incentives. Therefore, it is estimated that implementation of environmental regulations on a federal level will affect the demand for sustainable solutions in general, and EVs in particular, in the U.S.

U3 Cell Manufacturing in the U.S. and U4 Demand in the U.S. (+). Several respondents pointed out the direct relationship between demand and cell manufacturing. The respondents point out that an increase in demand for EVs in the U.S. will positively impact domestic cell manufacturing. Moreover, as discussed earlier in this section, the slow growth rate of cell manufacturing in the U.S. can be explained by low demand in EVs. Hence, the correlation between U3 and U4 is positive.

U3 Cell Manufacturing in the U.S. and U5 LIB Cell Ecosystem (+). The uncertain outcome of the development of cell manufacturing in the U.S. is defined to impact the development of the ecosystem. Many respondents discuss that all parties in the ecosystem need to develop simultaneously. For the ecosystem to grow, it is essential that cell manufacturing grows, since the ecosystem is dependent on the cell manufacturers. Otherwise, there will be a bottleneck situation in the battery industry. Contrarily, if the development of cell manufacturing slows down, there is no need for the ecosystem to develop further. For a sufficient ecosystem to emerge it is essential that cell manufacturing grows as well. Hence, the correlation between cell manufacturing in the U.S. and the ecosystem is positive.

U3 Cell Manufacturing in the U.S. and U8 Human Capital (+). If cell manufacturing in the U.S. increases, it would most likely result in human capital to increase. Thus, one factor will most likely not happen without the other. It seems like one of the biggest prerequisites for cell manufacturing to take place in the U.S. is to get more human capital. The respondents mentioned inertia in the industry, and that it at one hand is hard to move the actual building (e.g. the manufacturing facility) due to high investments, at another hand it is inertia in getting people to move. The two factors are thus very important for each other at the same time as it hinders the other one to take off.

U4 Demand in the U.S. and U5 LIB Cell Ecosystem (+). The demand for EVs in the U.S. is highly unpredictable, and it has to do with the lack of a sufficient ecosystem. The data showed that if the entire ecosystem were developed simultaneously throughout the entire supply chain, the shift would be faster and easier. The problem is that in order for the development of the ecosystem to take off, the demand must increase since customers are a big part of that journey. It is a catch 22 situation, were the two factors depend on each other and thus the two uncertainties have a positive correlation.

U4 Demand in the U.S. and U7 Cells as Core Business (+/-). The development of the demand for EVs will likely have an effect on the decision for OEMs to view cells as core business. The economies of scale are dependent on demand, and OEMs would not invest in cell manufacturing if they did not see an increase in demand for EVs. It would not be economically reasonable to invest in cells as core business if there was a low demand for EVs. However, if the demand for EVs increase, the manufacturing of LIB cells can increase as well, causing OEMs to more easily outsource the LIB cell to a competitive supplier base. Therefore, the correlation between these two uncertainties can be described as both positive and negative.

U5 LIB Cell Ecosystem and U8 Human Capital (+). The sufficient ecosystem is dependent on that development is increasing at all levels at the same time, thus, human capital must be present in order for the ecosystem to be sufficient. Human capital is also dependent on the ecosystem to be sufficient since competence must be present at multiple levels throughout the whole supply chain. Hence, the correlation is deemed positive.

U5 LIB Cell Ecosystem and U9 Technology Risks (-). If the ecosystem around EVs develops throughout the whole supply chain, it is likely that the risks of 'betting at the wrong horse' decreases. The ecosystem is important in order for everyone in the industry to be on the same page. If everyone is on the same page, it would imply fewer risks for investing in the wrong technology, moreover, it would be easier to switch if the ecosystem was well developed. Thus, if the development of a sufficient ecosystem occurs, the technical risks most likely decrease.

U6 Bargaining Power and U7 Cells as Core Business (+/-). The correlation between these two uncertainties is both positive and negative as the development of the two could go both hand in hand and in opposite directions. If the bargaining power remains with the cell manufacturers, it will be hard for the OEMs to secure cells and they face a risk of not being able to produce EVs to meet demand or to buy products with less quality. Hence, OEMs might view undertaking production of cells in-house as necessary to enhance their competitiveness. If the power structure was in favor of the OEMs, having cells as their core competence would not be as necessary as they easily can buy from the cell manufacturers and require high quality. However, cell manufacturers retaining the bargaining power could also depend on a low demand for EVs and consequently LIB cells, and that few manufacturers monopolistically control the market. Hence, the correlation is both positive and negative as it is highly affected by the demand for EVs.

5.3.2. Trend Impact Analysis

In step two of the scenario planning, the identified development factors were divided into trends and uncertainties where trends were described to have a certain outcome. Since the trends have a certain outcome, they will occur regardless of the outcome of the uncertainties why they are important to consider. Below follows a short description of the trends' impact on the uncertainties and thus the automotive industry at different levels.

The trend toward more sustainable states (T1), involving environmental initiatives on state level, is likely to influence the demand for EVs in the U.S. to go up (U4). Moreover, the trend can have a positive impact on environmental regulations (U1) on a federal level since, already today, California is described to play an important role in impacting the rest of the country. The trend (T1) could also make it easier for cell manufacturers to start production in the U.S. (U3) given that demand goes up, thus, the cell manufacturers' incentives increase. Lastly, more sustainable states could also influence the presidential election, thus, the presidential impact (U2). Demand for EVs in the U.S. (U4) is positively influenced by charging infrastructure (T6) which was stated to not be a hinder toward EVs by the respondents.

Another trend influencing the whole industry is the development of LIB cells (T9), which during the time-frame of ten years was set to be certain as LIB cells are continued to be used in EVs. Even if there was a discussion of new technologies entering, a completely new breakthrough in the industry could not be identified to influence the industry. Thus, the trend of continuous development of LIB influences firms to invest in the current technology which could be an incentive to start more facilities of cell manufacturing in the U.S. (U3). This trend (T9) is also deemed to influence the bargaining power (U6).

Whether cell manufacturing in the U.S. (U3) will increase has also a lot to do with USMCA coming into force (T2) and the protectionist moves (T5). When USMCA is in effect it implies higher costs for OEMs since they will be forced to source domestically and can no longer take advantage of global trade. The trend of protectionism in the world is also something preventing free trade agreements worldwide, and it seems like in the case of LIB cell manufacturing, protectionism will be characteristic, and each country might start producing cells themselves. Since it was clarified that there are no possibilities of withdrawing USMCA (T3), the RVC requirements will be effective in the near future. The effects of the RVC requirements (T4) was said to imply higher cost for OEMs importing from abroad and exporting within North America, and at a certain level, OEMs will not be able to bear the cost which also could be something influencing the cell manufacturing in the U.S. (U3). These trends indirectly affect the development of the LIB cell ecosystem (U5) since an increased cell manufacturing in the U.S. most likely results in a sufficient LIB cell ecosystem and vice versa. The same implies for human capital (U8) since an increase in cell manufacturing requires enhanced human capital.

There is a trend of collaboration between OEMs and cell manufacturers (T7). This trend means that, regardless of the uncertainties' outcomes, a relationship between OEMs and cell manufacturers will occur in some way. A big question discussed was whether OEMs should take on cell manufacturing themselves (U7), and this was set to be a big uncertainty, however, there is a trend of OEMs undertaking manufacturing and development of modules and packs (T8) in-house. Both the trend of increasing collaborations with cell manufacturers and making modules and packs in-house point at the technology risks (U9) will be reduced due to OEMs' ability to more easy switch technology and adapt their vehicles accordingly.

5.4. STEP 4 - SCENARIO BUILDING

After determining the correlations between the uncertainties and the impact of the trends, the initial construction of the scenarios can be made. The fourth step involves building different scenarios based on the earlier identified uncertainties and trends. As described by Schwenker and Wulf (2013), the uncertainties lay the foundation for the two scenario dimensions, which will be outlined in this step. Firstly, the dimensions of the scenarios are described, consisting of bundles of uncertainties. Thereafter, the scenario matrix with the extreme values is presented. Lastly, the four different scenarios are presented.

5.4.1. Constructing the Scenarios

The fourth step begins clustering identified uncertainties together into two dimensions. The uncertainties clustered are based on the predetermined two criteria mentioned in *Table 2.4*. The first criterion is that the uncertainties must qualify for having a high relative impact on OEMs in the automotive industry. The second criterion is that the uncertainties must be able to cluster together in one dimension. Hence, the most impactful uncertainties and the uncertainties they affect, also with high impact, are clustered together.

The most impactful uncertainties that also correlate are U1, U2, U3, U4, U6, and U7. These will hereinafter be clustered into two separate dimensions and put to their extremes. The clustering is based on the correlations determined in the previous step, illustrated in the correlation matrix, to assure plausibility and consistency in the scenarios. This allows for four different future scenarios to be illustrated, within which four consistent and plausible courses of actions can be outlined (Schwenker & Wulf, 2013). The remaining three uncertainties U5 Ecosystem, U8 Human Capital, and U9 Technological Risks for OEMs are explained to not have a significant impact on OEMs, why they are not included in the two dimensions.

Dimension 1 – Environmental Engagement

The first dimension is a bundle of four uncertainties all impacting each other in some way. The uncertainties bundled in dimension one are U1 Presidential Impact, U2 Environmental Regulations, U3 Demand in the U.S., and U4 Cell Manufacturing in the U.S. The correlation matrix illustrated the correlation between all the uncertainties which in turn implies two outcomes, creating two extreme values. If just one of the uncertainties occurs, it implies the others to follow, thus they have been bundled to either push for more sustainable solutions at one end, or at the other end restrain the shift toward electrification. As the respondents stated, there is a need to incentivize on a federal level to put environmental regulations in place to push for the shift. Even though there is a trend of environmental incentives at state level, an additional need at federal level was identified. Because of this, presidential election was also set to influence this dimension, where a president with great environmental concerns will push for more sustainable solutions and a president who does not believe in climate change restrains the shift. Demand for EVs in the U.S. was also said to be depending on regulations as the low cost of fuel implies an ICEV to be much more economically beneficial for customers than an EV. Lastly, demand for EVs influences cell manufacturing in the U.S. whereby it also was bundled in this dimension.

Dimension 2 – Balance of Power

U6 Bargaining Power and U7 Cells as Core Business are the uncertainties bundled to build the second dimension. Just as in the first dimension, these factors have two outcomes. Shortly explained, it is deemed that if OEMs have the bargaining power there is no reason for them to produce the cells themselves as they can control and guide the cell manufacturers to produce for them. Having cells as core business might be difficult because it requires entirely new capabilities. At the same time, it might be necessary if EVs become the new core business for OEMs. The two uncertainties have been bundled together creating two extreme values. At one extreme, OEMs retain the bargaining power and does therefore not view the LIB cells as core business. At the other extreme, the competitive landscape has changed, and OEMs are in need of new business models where they view LIB cells as core business since cell manufacturers hold the bargaining power.

Scenario Matrix

By taking these two dimensions to their respective extremes, four different scenarios are outlined, illustrated in *Figure 5.5*. It does not occur a correlation between the uncertainties in the two dimensions, why these four extreme future scenarios are possible. The scenarios are plausible and relevant in the chosen time-frame for the automotive industry, illustrating four potential outcomes for how the industry can look in 2030. In the following section, the four future scenarios will be explained thoroughly describing the most suitable sourcing mode for LIB cells for OEMs in the U.S. This includes taking the perspective of the ten-year time-frame, explaining how the situation will look in 2030 and what effects it will have on OEMs. Moreover, as is highlighted by both Schoemaker (1995) and Schwenker and Wulf (2013), each scenario will be illustrated by an influence diagram that simplified shows how each scenario emerges taking the uncertainties and relevant trends into consideration. To enhance trustworthiness and visualization, each scenario also has a captivating title and is described through compelling storytelling (Schoemaker, 1995; Lindgren & Bandhold, 2003).

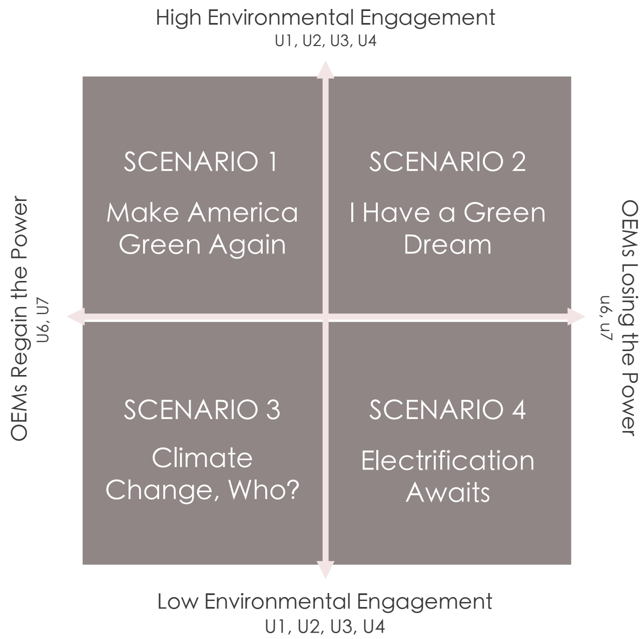

Figure 5.5. Scenario Matrix Based upon the Two Dimensions.

5.4.2. Scenario storylines

Four thorough narratives corresponding to the scenarios are presented below as storylines. The storylines map out the development of EVs in the U.S., cell manufacturing, and the role of OEMs for each scenario. Due to the time-frame of ten years, each scenario is described from the perspective of 2030. The uncertainties lay the foundation for the scenarios and the outcomes of the scenarios are based upon the four quadrants in the scenario matrix in *Figure 5.5*. The trends are also applied as they have an impact on the uncertainties and the future development of the industry. However, as underlined by Schoemaker (1995), trends are weighted differently in each scenario. In *Appendix D,* the course of action for elaborating the scenarios are illustrated in influence diagrams to more clearly show the relationships between the uncertainties, trends, and the outcome.

SCENARIO 1

MAKE AMERICA GREEN AGAIN

For the last ten years, the American market has fought to catch up with the rest of the world in the push toward electrification. Naturally, the charging infrastructure has also increased at the same pace. The demand for EVs has increased tremendously in the country. This is due to an increase in the environmental engagement at both state and federal levels. The president, who is highly engaged in fighting climate change, has incentivized the shift toward EVs. The U.S. has also rejoined the Paris Agreement making the strive to lower CO_2 emissions of even greater importance. The environmental regulations have increased fuel prices and incentivized the purchasing of EVs. Ten years ago, no one would have thought that an EV could be as economically beneficial as an ICEV.

China used to be the world leader of cell manufacturing but due to the continuous increase in demand for EVs in the whole world, China no longer has enough capacity to provide cells globally. This, in combination with more protectionist moves in the world, has resulted in cell manufacturing facilities all over the world, including in the U.S. The incentives from the president has eased the process of firms investing in the country, and this has led to both foreign firms and domestic ones to initiate cell manufacturing is the U.S. For OEMs, this has been beneficial as it allowed for them to meet the RVC requirements of USMCA. Cell manufacturers in the U.S. are of very good quality as the human capital has moved along with foreign firms investing. Buying cells from abroad is not as common as it was ten years ago since the manufacturing of cells has become more dispersed globally.

The great amount of cell manufacturers in the U.S. has led to a sufficient supply of cells as well as a competitive supplier base. Cell manufacturers are fighting for the OEMs to buy from them. The LIB cell market is characterized by a wide range of manufacturers and low differentiation, therefore there are low switching costs. OEMs can easily switch between suppliers as they have retained their bargaining power in the automotive industry. As a result of the increase in cell manufacturing in the U.S., the LIB cell is not as exclusive as ten years ago. The OEMs more or less view the LIB cell as a standardized good and, therefore, outsourcing is the preferable choice. Even though the LIB cell still is a key component in EVs, there is no reason for OEMs to produce it in-house. However, the trend during the last ten years has been to move modules and pack into the core business of OEMs resulting in OEMs producing them in-house. Due to their high bargaining power, OEMs can also influence the cell manufacturers to make cells that fit their needs since they still have high expectations on quality standards.

SCENARIO 2

I HAVE A GREEN DREAM

In 2030, the American president cares deeply about the environment. Environmental regulations such as taxes on fuel and CO_2 emission regulations have been enforced on a federal level. Overall, the president encourages sustainable solutions. One reason for why this president got elected was because more states in the U.S. started to follow the regulations of the greener ZEV states. There is an increased demand for EVs in the U.S. and the U.S. is no longer perceived to have a lower demand for environmental solutions in comparison to other countries. There have also been high investments in charging infrastructure domestically, which benefit the demand for EVs.

The supply of LIB cells in the U.S. has increased, mainly due to the increase in demand for EVs. Nevertheless, protectionism has continued to grow throughout the world, and especially in the U.S. This has had great effects on world trade and foreign investments and has hindered new cell manufacturers to enter the American market. Foreign cell manufacturers perceive great risks of investing in the country, and therefore only the established, large cell manufacturers have gained a strong market position. Hence, even though the supply of LIB cells has increased in the country due to environmental regulations and demand, the LIB cell market is still dominated by a few cell manufacturers. Therefore, the bargaining power has grown even stronger with cell manufacturers during the past ten years.

The evolution throughout the last ten years has consisted of a conflicting situation for OEMs in the automotive industry. On one hand, the demand for EVs increases alongside a continuous decline in sales of ICEVs. On the other hand, the cell manufacturers still control the market since supply has not increased enough to meet the demand. Moreover, the cell manufacturers are putting high pressures on OEMs to share knowledge on EV manufacturing to enhance their market position further. OEMs have been put in a difficult position. This evolution has caused them to rethink their business model and they have an increasing interest in internal development of required capabilities. The LIB cell is still a key component in an EV and the need for backward integration is still high, especially as the supply of cells is relatively low. The only way for OEMs to remain competitive and stay at the forefront in the automotive industry has been to value the LIB cell as core business and initiate manufacturing in-house. It has been clear that the OEMs who did not view the LIB cell as core business did not survive in the competitive landscape of the automotive industry. Several OEMs that possessed a great market share in 2020 are struggling to survive the shift toward electrification.

Due to various domestic incentives and regulations, both at state and federal level, OEMs now recognize the potential of investing in LIB cell technology. Tesla was known as the pioneer of making LIB cells in-house and controlling a majority of its supply chain, and now the traditional OEMs have followed the same path and enhanced their involvement in the supply chain of LIB cells. The EV does not exist without a cell and there are great benefits of developing the vehicle together with the cell for maximum performance.

SCENARIO 3

CLIMATE CHANGE, WHO?

Even if the demand for EVs has increased in the rest of the world during the last ten years and cell manufacturing is dispersed throughout the world, the same trend has not successfully influenced the American market. The reason for the slow shift toward electrification seems to be related to the low incentives for sustainable solutions. Even though some states still are passionate for sustainability and pushes toward more sustainable solutions, the demand for ICEVs are still high in the U.S. The fact that the U.S. has not enforced stricter CO_2 emission regulations, in combination with low cost of fuel is likely the reason for the continuous demand for ICEVs.

The low demand for EVs has led to OEMs not having problems with securing LIB cells to meet demand in the U.S. The amount of cell suppliers is low in the U.S., in fact, the amount of manufacturers has increased at a slower pace than the forecasts showed in 2020. One explanation for the low investments in the country is the ongoing trend of protectionism, hindering foreign manufacturers to invest in the U.S. However, OEMs can still source cells from manufacturers outside the U.S. and bear the extra cost of the tariffs that has increased due to USMCA. The increased tariffs result in higher prices for the end-consumer, however, this is not considered an issue because the few consumers have low price sensitivity.

LIB cells are not viewed as core business for the OEMs since the customers still demand ICEVs. There is still a market for EVs even if less widespread than the forecasts said ten years ago. The amount of cell manufacturers globally is still relatively few. The OEMs hold strong bargaining power since the cell manufacturers depend on them. Without the expertise from OEMs, cell manufacturers cannot accommodate the features and qualities needed in an EV, thus, they lose competitiveness.

Ten years ago, the expectations on EVs were high, but there was an overestimation in how much the LIB could be improved. Also, the disruption in the automotive industry has stagnated and the traditional ways of sourcing where OEMs hold the bargaining power seem to last longer than expected. Due to their bargaining power, OEMs can get cell manufacturers to produce differentiated cells to fit the vehicle. This also allows for OEMs to easily fit the cells in the modules and packs made internally. However, the OEMs still plan for a future shift since the EV market is increasing whereby they keep good relationships with the cell manufacturers. Moreover, since the cell manufacturers know they are dependent on the OEMs to survive they also want to keep good communication and produce cells in consultation with OEMs.

SCENARIO 4

ELECTRIFICATION AWAITS

The fourth scenario provides a future highly similar to 2020. No one was surprised to see that the succeeding president shared a lot of the same values as President Trump. The new president continued on the same path as President Trump, keeping the country protectionist and neglecting environmental regulations. Today in 2030, the U.S. has had a slower adoption to sustainable solutions than most countries globally. There is a lack of incentives from the government, hence a non-regulatory push cause most of the domestic firms to simply do the bare minimum in terms of sustainability.

Even though environmental regulations have been put aside on a federal level, the states with a green aspiration impact the demand to a slight degree. On a global level, the demand for EVs has grown, however in the U.S., there is a slow adoption rate and merely certain firms and public services demand EVs. USMCA has had an important part in this development as well as the protectionist trend. The latter has caused foreign firms to reconsider building a cell manufacturing facility in the U.S., and due to the low demand for EVs, domestic cell manufacturers have not appeared. Moreover, the effects of USMCA have caused OEMs to pay the tariffs of importing the cells from other countries as there is no domestic supply, causing the prices of EVs to increase. This, in turn, negatively impacts the demand for EVs even more, causing the situation to be somewhat of a catch 22.

Since the supply of cells does not meet demand, the OEMs does still not possess any bargaining power over the cell manufacturers. The situation is similar to the one ten years ago, and therefore the OEMs face somewhat similar challenges as then. A difficulty for OEMs is to offer competitive vehicles in terms of quality and cost without having control over the manufacturing of the LIB cell. Since cell manufacturers maintain bargaining power over OEMs, creating a joint venture with a cell manufacturer has continuously been a success factor for OEMs. Many OEMs co-create the cells with the cell manufacturer to enhance performance and easier combine the cell with the rest of the vehicle. This has been seen as the preferred way of securing LIB cells to enable staying at the forefront and meeting customer demands. Moreover, the cell manufacturers view OEMs as a preferable partner, and because of their importance as a customer, the cell manufacturers are committed to their success. The OEMs have innovative goals and they identify a need for having the cell as core business. However, they cannot achieve these goals alone. Through sharing knowledge with the cell manufacturer, the performance of the vehicles is enhanced, thus, OEMs' competitiveness is enhanced.

5.5. STEP 5 - DEFINING STRATEGIC ACTIONS

In this step, strategic actions and recommendations for each scenario can be formulated based on the four identified scenarios in the previous step. This allows for the scenario planning to be connected to the theoretical framework of sourcing models. Hence, OEMs will be guided in each potential future scenario with support from established research.

In Scenario 1, Make America Green Again, the supply of LIB cells is high as well as the demand for EVs. There is a high number of suppliers and since the LIB cell is close to standardized and there are economies of scale in manufacturing. OEMs can, however, still require high standards. Because of a large and competitive supplier base, the OEMs hold the bargaining power, thus, they can steer manufacturing to meet their specific demands. If suppliers are not compliant with the standards, they get replaced. According to Jones (2004), these aspects implies a favoring for OEMs to buy the products. The same is identified when looking at the sourcing continuum. As this situation shows similarities to both the 'Basic Provider Model' and the 'Approved Provider Model' it is placed in the field of transactional sourcing models as illustrated in *Figure 5.6.* (Vitasek, 2016). Thus, the strategic actions for OEMs in this scenario will be to outsource the LIB cell to cell manufacturers whilst also having the possibility of requiring high standards.

In Scenario 2, I Have a Green Dream, the demand for EVs has increased, however, few cell manufacturers are still dominating the market allowing them to gain even stronger bargaining power. The cell manufacturers increasing importance in the supply chain for EVs creates opportunities to enter the automotive industry. This creates a threat for OEMs since this jeopardizes their competitiveness. OEMs cannot ensure that cell manufacturers act in their best interest, creating an opportunistic situation (Jones 2004). Moreover, OEMs have realized the importance of LIB cells. To not be outperformed by more technology-based competitors, OEMs need to integrate cell manufacturing and view it as core business. This is stressed by Prahalad and Hamel (1990) who state that long-term competitiveness derives from internal resources and core capabilities. Furthermore, it is only possible to focus on a few core capabilities, but since ICEVs are less important in this scenario, focusing on the LIB cell technology is viable (Prahalad & Hamel, 1990). Due to a small number of suppliers, opportunism, and uncertainty, the second scenario is positioned to the far right in *Figure 5.6.* where OEMs make investments for internal development of the required capabilities.

Scenario 3, Climate Change, Who?, looks rather similar to the situation in 2020. The OEMs hold the bargaining power and the traditional power structures in the automotive industry are regained. Because of the low demand for EVs and high bargaining power for OEMs, the LIB cell is not deemed to be a core business. Connecting to the sourcing continuum, the suitable sourcing mode in this scenario is the 'Preferred Provider Model'. This mode allows OEMs to meet their strategic goals for EVs, at the same time as cell manufacturers add important value to the business (Vitasek, 2016). With a low demand for EVs, OEMs do not want to make investments in cell technology, hence, they are forced to rely on suppliers to drive innovation and enhance improvement (Vitasek, 2016). To ensure innovation and improvements, OEMs can through their bargaining power collaboratively drive innovation with its suppliers. Thus, performance is enhanced without investing, whereby Scenario 3 is positioned as a relational mode in *Figure 5.6.*

Scenario 4, Electrification Awaits, provides a future where domestic cell manufacturing has not been initiated, whereby OEMs import the LIB cells to the U.S. There is low demand for EVs in the U.S., however, there is still reason to believe that the shift toward electrification will occur in the future.

OEMs view the LIB cell as core business due to the growing demand globally but since cell manufacturers have strong bargaining power, OEMs are in need to build close relationships to stay competitive. Both cell manufacturers and OEMs benefit from collaborating as it generates synergies and creates mutual value. OEMs get the possibility of securing LIB cells and differentiating their vehicles with specialized cells. Cell manufacturers also benefit from gaining knowledge into the automotive industry and developing LIB cells with sufficient quality for vehicles, enhancing their competitiveness as well. Outsourcing is not a preferred option due to the low bargaining power of OEMs, also internal capabilities are not adequate, pointing at an 'Equity Partnership' to be preferable as illustrated in *Figure 5.6.* (Vitasek, 2016). Moreover, combining the resources is beneficial as it increases productivity along the supply chain, lowers costs, and increases product differentiation (Dyer & Singh, 1998).

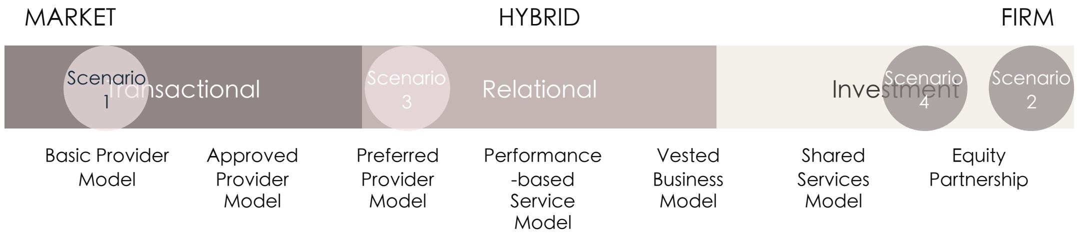

Figure 5.6. Sourcing Continuum Illustrating the Sourcing Mode of Each Scenario.

The four scenarios result in four different sourcing models being preferable. Which of the four scenarios that will take place in 2030 is still uncertain. Moreover, since the four scenarios are based upon the extremes of the two dimensions, neither scenario is assured to happen. In reality, it will likely evolve in much more complex ways containing elements of all scenarios. To be profitable and remain competitive in this shift, OEMs need to apply the proper boundaries (Dahlstrom & Nygaard, 2010). This implies continuous difficulties for what strategic decisions OEMs should make. Being aware of the possible scenarios is of great importance as it enables OEMs to recognize signs of change in the market. However, to more efficiently prepare for strategic actions, formulating a core strategy adaptable to all four scenarios is highly beneficial. A core strategy is formulated by looking at the common elements of all scenarios (Schwenker & Wulf, 2013).

To determine the appropriate sourcing mode, determining the characteristics of the LIB cell and the industry is essential as it affects the choice of 'make or buy?'. It is explained that economies of scale are necessary for profitable cell manufacturing, meaning that outsourcing to cell manufacturers is preferable (Jones, 2004; Lyons, 1995). Moreover, since the LIB cell involves technological uncertainties, the market is preferable as it provides flexibility for new technologies to avoid a lock-in position with obsolete technologies (Geyskens et al., 2006). However, the LIB cell is also a specific asset since differentiation is possible and the cell determines the attributes of the vehicle, e.g. driving range, performance, and power. Also, co-developing the cell together with the vehicle is favorable. This points to the choice of OEMs undertaking manufacturing in-house (Jones, 2004). Moreover, proximity is described as important in the automotive industry, and OEMs are used to have their suppliers nearby for logistics reasons. The LIB cell adds additional complexity as the transportation is classified as hazardous goods, meanwhile, the supply of raw material is limited to certain geographies. Nonetheless, this factor enhances the degree of asset specificity, pointing at making the cells in-house being the best option (Dyer & Singh, 1998). Lastly, the automotive industry requires backward integration for the LIB cells which also favors OEMs taking on the manufacturing of LIB cells in-house.

There is a strong reason to believe that OEMs should take on the manufacturing of LIB cells in-house. Prahalad and Hamel (1990) favors in-house production in the long-term and argue that internal capabilities enable long-lasting competitiveness. However, the choice of 'make or buy?' is not dichotomous, but rather continuous. This is visualized in *Figure 5.6.*, where the four scenarios are positioned along the entire continuum. Scenario 1 and Scenario 2 are widest apart in the sourcing continuum, creating the most extreme conflicting elements. Even so, a common element is perceived to be the relationship between OEMs and cell manufacturers. Inspired by the hybrid approach on sourcing modes, taking a collaborative position in sourcing allows for advantages from both make and buy to be obtained (Williamson, 2008). This means that OEMs can take part in the development of the LIB cell and make joint investments without baring all risks. At the same time, OEMs do not have to rely on the suppliers to innovate and enhance performance. Moreover, it provides competitive advantages such as shorter product development cycles and lower costs along the supply chain (Dyer & Singh, 1998).

Through collaboration and close relationships with cell manufacturers, OEMs can build a strong network that is especially important in an uncertain and volatile business environment (Vitasek, 2016). Taking a relational sourcing mode, OEMs play a valuable role in the future development of LIB cells suitable for the automotive industry, independent of power structures. According to Dyer and Singh (1998), know-how is acquired through long-lasting relationships. The collaborative relationship creates a win-win situation where OEMs gain competencies from cell manufacturers, and vice versa. By continuously monitoring the environment and especially the identified uncertainties, OEMs can easily adapt the core strategy to whatever changes occur. Depending on how the future develops, OEMs can, in the case of low bargaining power and high environmental engagement in the U.S., further engage in cell manufacturing, i.e. vertically integrate the manufacturing of LIB cells. Whilst in the case of high bargaining power, OEMs can take a step back and let the established network function as suppliers, i.e. buying from the market. In the other two cases, a close relationship and collaboration with cell manufacturers persist.

6. CONCLUSION

The sixth and final section summarizes and concludes the results of this research. Initially, the research questions are answered followed by concluding remarks outlining the recommendations for how OEMs strategically can prepare for the future. Thereafter, the learnings and implications of this research highlighted. Lastly, future research is suggested based upon the learnings and delimitations.

6.1. ANSWERING THE RESEARCH QUESTIONS

This research aimed to, from the perspective of an OEM, investigate the possible future outcomes of the automotive industry's shift toward electrification in the U.S. to identify how OEMs can source LIB cells. The purpose was to investigate what sourcing mode for LIB cells OEMs can take today in order to adapt to future changes and meet the demand for EVs. To fulfill the purpose, trends and uncertainties affecting the evolution of the industry of EVs were identified, within a time-frame of ten years, to determine how OEMs can remain competitive. The two sub-questions developed will be answered first, resulting in substantiated arguments to answer the main question.

- What trends and uncertainties affect the future supply of lithium-ion battery cells?

Three areas of investigation were predetermined to have a significant impact on the development of LIB cells, these are politics and trade, market development, and technology. These three areas were examined to identify trends and uncertainties. The trends had a high impact on OEMs and the outcome was uncertain, whereas uncertainties had an uncertain outcome yet still a high impact. 21 semi-structured interviews resulted in an identification of nine trends and nine uncertainties. Within politics and trade, the trends involved sustainable regulations continuously will be enforced on a state level, the implications and effects of USMCA resulting in challenges for OEMs, and that protectionism is increasing globally. Within market development, the trends include that charging infrastructure is not to be seen as a hinder and that OEMs are increasingly involving themselves in the LIB cell supply chain. Lastly, within the area of technology, it was defined that the LIB will remain relevant in EVs and that continuous improvement will occur. The nine uncertainties included, for instance, changes in environmental regulations on a federal level in the U.S., the development of demand for EVs in the U.S., and what risks and constraints exist toward the development of cell manufacturing as well as the LIB itself.

Since the trends have a certain outcome, they all have an impact on the development of the industry. However, the uncertainties have an uncertain outcome and were thereby limited to two dichotomous outcomes in order for their influence to be determined. The correlating uncertainties with the highest impact were bundled into two dimensions. This resulted in two dimensions consisting of six uncertainties shaping the development of the supply of LIB cells in the U.S. The first dimension is Environmental Engagement which involves the level of environmental regulations and financial incentives on a federal level, mainly determined by the president, affecting both demand for EVs and domestic cell manufacturing in the U.S. The second dimension is Balance of Power which includes the level of bargaining power for OEMs and their view on the LIB cell as core business.

- What are the future scenarios for the market of electric vehicles in the United States?

By putting the two identified dimensions to their extremes in the scenario matrix, four plausible future scenarios are outlined. Hence, the future scenarios for the market of EVs in the U.S. can take four different shapes. (1) High environmental engagement in combination with OEMs holding the bargaining power leads to Scenario 1, Make America Green Again. (2) High environmental engagement in combination with cell manufacturers holding the bargaining power leads to Scenario 2, I Have a Green Dream. (3) Low environmental engagement together with bargaining power for OEMs result in Scenario 3, Climate Change, Who? (4) Low environmental engagement together with bargaining power for cell manufacturers result in Scenario 4, Electrification Awaits.

The answers to the two sub-question summarize the scenario planning process which provides a thorough contexture to answer the main question:

What sourcing mode for lithium-ion battery cells can original equipment manufacturers take to meet future demand in the United States?

The sourcing mode preferable for OEMs in the future depends on how the future evolves. Each specific scenario has been connected to established sourcing theories to determine the most suitable sourcing mode respectively. For Scenario 1, the preferred sourcing mode is positioned within transactional sourcing, thus, the manufacturing of LIB cells is outsourced. Scenario 2 is placed on the far right end in the sourcing continuum, meaning that OEMs should invest in internal capabilities and in-house manufacturing of LIB cells. Thus, acquiring the capabilities and making the improvements themselves. Scenario 3 is positioned within relational sourcing, pointing at a more collaborative sourcing mode to be preferable. Hence, OEMs are outsourcing the production of LIB cells whilst being involved in co-developing the LIB cells. In Scenario 4, OEMs are suggested to invest jointly in cell manufacturing together with cell manufacturers by creating equity partnerships such as joint ventures.

Which of the four scenarios will take place is still uncertain, implying continuous difficulties for OEMs in preparing their strategic actions. Therefore, a core strategy was formulated, adaptable to all four scenarios. This allows OEMs to efficiently prepare their strategic actions to secure the future supply of LIB cells in the U.S. The core strategy involves engaging in cell manufacturing through collaboration with cell manufacturers to build a strong network. A relational sourcing mode is deemed sufficient for all four future scenarios and creates a good foundation for OEMs in this volatile and uncertain environment. By implementing the core strategy today, OEMs are prepared for future scenarios and can easily adapt to the future. Thereupon, OEMs can either ramp-up their engagement in cell manufacturing or take a step back and let the established network function as suppliers.

6.2. CONCLUDING REMARKS

This research provides recommendations for what OEMs should do today to strategically prepare for how to source LIB cells in the U.S. The recommendations are for OEMs to choose a relational sourcing mode to collaborate with cell manufacturers and create strong relationships. This allows OEMs to still influence and improve the manufacturing of the LIB cells to fit their vehicles by co-developing and sharing their own knowledge with cell manufacturers. By being aware of the potential future scenarios, OEMs can through closely monitoring the environment, the balance of power between OEMs and cell manufacturers, and the identified uncertainties, identify signs calling for adjusting the core strategy accordingly. The relational view of the core strategy provides a foundation upon which OEMs easily can adapt to future changes. It enables OEMs to invest in their own cell manufacturing due to enhanced capabilities in cell manufacturing as well as take a step back and allow the strong relationships with cell manufacturers to generate a competitive supplier base. Hence, OEMs' competitive advantages are strengthened regardless of how the future turns out.

6.3. IMPLICATIONS OF RESEARCH

Academic research aims to understand the world and how it will develop in the future. The researchers uncovered a lack of research designs suitable for investigating future development why scenario planning was found appropriate. Scenario planning is a framework or tool mainly developed to be used in practice in an organizational context. Since this research takes an academic viewpoint, a customized scenario planning framework was developed, intertwining academia with practice. Based upon this, the researchers want to highlight two key implications.

(1) Academic research often investigates a specific situation under certain circumstances which can create challenges in applying the results in a business context. However, by using a practical tool, this academic research resulted in recommendations and strategic actions to easily be understood by the industry. Moreover, this customized framework did not include the step of implementation. The recommendations are nonetheless easy for OEMs to adapt due to the practical approach of scenario planning.

(2) Conducting scenario planning in an academic context enabled the building of scenarios through scientific research integrating the theoretical view on sourcing. Integrating other theories into the scenario planning process has not been highly exploited in earlier research. The researchers have identified this combination to be of great value. Not only did this approach allow investigating a future perspective unavailable by other research designs but also to take an iterative approach connecting findings to a theoretical framework.

By using a customized scenario planning framework, a practical tool can be combined with a more theoretical viewpoint resulting in a new dimension of the academic contribution. It is deemed that a more practical tool can facilitate academic research and especially when investigating the future. This provides valuable implications for future research. The researchers want to highlight that customizing the framework to be applicable in a business context, whilst still having a theoretical viewpoint, enhanced the academic contribution.

6.4. FUTURE RESEARCH

This research has taken an external perspective on how OEMs can source LIB cells in the future in the U.S. The recommendations are consequently based on factors identified on a macroeconomic level and the defined strategic actions are intended for OEMs in general, allowing deeper investigation of specific areas for future research.

As stated initially, to implement the strategic actions recommended in this research, an additional step taking an internal viewpoint is needed. This requires the strategic actions recommended to be accommodated to the specific situation for each OEM. By taking an internal viewpoint, an OEM can ensure that the strategy fits into the business model and internal competences of OEM. This allows for implementation and thorough monitoring to enable a competitive position in any of the future scenarios of the automotive industry.

Moreover, this study focuses on the LIB. However, as implied in the research, there are potential new technologies emerging. New breakthrough technologies replacing the LIB were mentioned by all respondents to play a significant role in the future, yet, this was not applicable within the time-frame of ten years. Nevertheless, these new technologies may emerge within the time-frame allowing for commercialization in the automotive industry after the time-frame. Hence, a further investigation in these new technologies is of interest as it might have a significant impact ten years from now. Moreover, this research merely included a mapping of the new technologies and not a thorough investigation of what the next technology will be. Further research into these new technologies is also of interest as it might influence both investments in cell technology as well as the development of the formats of EVs.

Lastly, the focus on the U.S. is highly contemporary due to the new regulations of USMCA, however, determining the most suitable sourcing mode for LIB cells is a global issue. Hence, it is interesting to further investigate the global development and countries other than the U.S. This was merely touched upon when identifying the development of cell manufacturing in the ROW. However, a more thorough investigation is highly relevant for OEMs as the automotive industry is global and the global supply of LIB cells is crucial for OEMs.

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APPENDIX A

Interview Guides

(1) Give a short explanation about the researchers, the thesis, its purpose and the research question:
- *Our research aims to suggest strategic actions for OEMs to secure the future supply of Lithium-ion battery cells in North America. With everything happening politically and environmentally today, more companies plan to source domestically, and we therefore want to look into the market in North America and the possibilities to source cells there or find other ways to secure the supply in the nearest 10 years.*

(2) Get an overview of the respondent:
- *Tell us a little more about you, your role and what you work with.*
- *Do we have your permission to record the interview?*
- *Are we allowed to publish your name and role in the final thesis?*

(3) Initiate with the general questions and choose a deeper area of investigation:

General questions:
- How important will it be to produce environmentally friendly products in the future?
- What do you see as possible solutions for securing the LIB cell?
- Will the supply chain need to change? Why?/Why not?
- Where do you think the manufacturing will take place?
- How will you purchase cells in the future?
- What do you think of collaborations within the supply chain?
- What are the switching costs in the supply chain?
- How can OEMS secure future supply in the U.S.? What possibilities do you see?
- How do you think the market will develop in terms of electrification?
- What role does OEMs play in the electrification? What role does cell manufacturers have?

Questions within Politics and Trade
- How does trade agreements affect OEMs?
- Are you familiar with the USMCA? Would you like to tell us about it?
- How would it affect import and export to/from the U.S.?
- When will USMCA come into force?
- How does USMCA affect companies/industries?
- How is USMCA different from NAFTA?
- What would be the cost for OEMs not sourcing domestically?
- What do companies need to consider when introducing the new agreement?
- Are there any exceptions for certain products when it comes to RVC?
- What is the reason / reasons for the United States introducing these trade agreements?
- Does the U.S. differ from other countries when it comes to trade agreements? How?
- What does the trade agreements mean for OEMs?
- How will investments in the U.S. be affected of USMCA?
- What role do presidents play in trade agreements (in the U.S.)?
- How will the USMCA be affected by a new president?
- How will the Electrification be affected by a new president?

Questions within Market Development
- How does the supply chain look in North America today?
- Where would it be possible to have EV manufacturing in the future?
- What are the possibilities for OEMs when it comes to sourcing battery cells in the U.S.?
- For example, an OEM in the U.S. buying components from Asia, will they continue to do so?
- How will investments in the U.S. be affected of the slow adoption toward electrification?
- How do you think the rest of the world will react to the slow adoption in the U.S.?
- Are there other factors and events affecting investment in the country? What?
- Could you describe the development of the United States In general? (infrastructure, electricity networks, labor market etc.)
- How come the U.S. are behind in the sustainability issue?

- How do you think the demand for electric vehicles will develop?
- What macroeconomic factors do you think will affect the future supply of LIB?

Questions within Technology

- How does the purchasing of battery cells work? And the battery overall?
- Development of batteries, how will the technology develop?
- How does the sourcing of LIB cells look today?
- Who has the bargaining power? OEMs or manufacturers?
- What is the next breakthrough of vehicle batteries?
- What are your thoughts on OEMS having the production in house?
- How will the supply of LIB cells in the U.S. develop?
- Will suppliers (cell manufacturers) start manufacturing in the U.S., When? Why/Why not)
- Do you think existinging cell manufacturers will move manufacturing to the U.S.?
- Tesla is making a lot if investments in the U.S., what are your thoughts about that?
- Will OEMs start manufacturing by their own?
- Are there any suppliers in the U.S. as of today that could secure supply?
- Would it be a possibility to collaborate with suppliers, or others?
- How do you think suppliers will act in the future? And in North America?

(4) End with thanking the respondent for participating and ask the final two questions

Final Questions:

- What do you think we need to investigate further to answer our research question?
- Do you know anyone else we should interview who could have good insight in this area?

APPENDIX B

The number of mentions by the respondents for each development factor

Below, an illustration of what development factors were mentioned (M) by which respondents is illustrated within the three areas of investigation. To distinguish the experts' opinions, as they are weighted higher, these are marked with an asterisk (*).

Politics and Trade

	Abdellaoui	Alvstam*	Balakrishnan	Berglund*	Burch*	Gillman	Grauers	Kellström	Koch*	Malmström*	Miller*	Respondent A	Silfvenius	Tintignac	Varney*	Whittingham	Åvall
Environmental Regulations			M			M	M	M	M	M		M		M	M		
Sustainable States	M					M		M	M	M		M			M	M	
USMCA in Force		M		M	M				M	M	M	M			M		
Ratification of USMCA		M		M					M	M	M						
Dysfunctional Judiciary in WTO				M					M	M							
Exemptions in USMCA		M			M					M	M				M		
RVC Requirements	M	M						M	M				M		M	M	
Protectionism		M				M		M	M	M			M				
Presidential Impact		M		M						M	M				M		

Market Development

	Abdellaoui	Alvstam*	Balakrishnan	Berglund*	Burch*	Gillman	Grauers	Kellström	Koch*	Malmström*	Miller*	Respondent A	Silfvenius	Tintignac	Varney*	Whittingham	Åvall
Environmental Regulations			M			M	M	M	M	M		M		M	M		
Sustainable States	M					M		M	M	M		M			M	M	
USMCA in Force		M		M	M				M	M	M	M			M		
Ratification of USMCA		M		M					M	M	M						
Dysfunctional Judiciary in WTO				M					M	M							
Exemptions in USMCA		M			M					M	M				M		
RVC Requirements	M	M						M	M				M		M	M	
Protectionism		M				M		M	M	M			M				
Presidential Impact		M		M						M	M				M		

Technology

	Abdellaoui	Balakrishnan*	Grauers	Groot*	Kellström	Larsson	Ledung*	Normark	Respondent A	Silfvenius*	Tintignac*	Varney	Whittingham*	Åvall*
Development of LIB	M	M	M	M			M	M	M				M	M
Breakthrough Technology	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Technology Risks		M	M	M	M		M	M						M

APPENDIX C

Correlations with no or unknown dependency

U1 Environmental Regulations and U5 LIB Cell Ecosystem (?) There is an uncertainty toward if reinforced environmental regulations will have an impact on the entire ecosystem of cell manufacturing. Just as is argued earlier, environmental regulations is what partly influenced Europe's industries to initiate local cell manufacturing. However, there is a discussion if this will impact the entire ecosystem or not. This has not been identified in neither primary nor secondary data, why this correlation cannot be determined, hence this relationship is marked with '?'.

U1 Environmental Regulations and U6 Bargaining Power (0) The outcome of bargaining power in the battery industry is highly uncertain, and several respondents discuss potential outcomes without knowing the most likely one. No respondent, however, mentions there to be a connection between environmental regulations and bargaining power. It is estimated to be unlikely that environmental regulation would impact which actor possesses the bargaining power of the battery industry, and vice versa, thus the correlation is marked to be neutral.

U1 Environmental Regulations and U7 Cells as Core Business (0) Federal environmental regulations and OEMs having the LIB cell technology as a core competence is not anticipated to influence one another. Instead, the environmental regulations are affected by domestic factors such as presidential election, and U7 is affected by OEMs strategic actions. Demand might be a common denominator with a positive influence on them both, but this does not generate a correlation between U1 and U7, why it is explained to be neutral.

U1 Environmental Regulations and U8 Human Capital (0) It is not expected to be a correlation between environmental regulations and human capital. Environmental regulations is explained by the respondents to impact the development of the EV industry. Human capital, on the other hand, is discussed to have an impact on the development of the battery industry, and lack of human capital hinders the development. No respondent mentioned a correlation between these two uncertainties, thus, they are estimated to be fully independent.

U1 Environmental Regulations and U9 Technology Risks (0) Within the subject of technological risks OEMs are facing, the respondents have discussed various factors such as flexibility, obsolete technologies, and difficulties of swapping cells. None of the risks brought up are related to environmental regulations, why the correlation between U1 and U9 is marked neutral.

U2 Presidential Impact and U3 Cell Manufacturing in the U.S. (?) Whether or not future presidential elections will affect cell manufacturing in US is uncertain. On one hand, there might be an indirect connection between a new president that enforces environmental regulations. As discussed earlier, this can have an impact on cell manufacturing in US due to demand and also it might increase financial incentives. Also, a big issue brought up by several respondents is the uncertainties and unreliability from the current president regarding investments in the U.S., especially by foreign firms. Therefore, a new president also might impact cell manufacturers. On the other hand, there is a rather unlikely course of action, and there cannot be found a direct correlation between U2 and U3. Therefore, the correlation between these two uncertainties is marked '?'.

U2 Presidential Impact and U4 Demand in the U.S. (0) The relationship between presidential impact and demand in the U.S. is deemed not to correlate. However, there is likely an indirect correlation between the two uncertainties. A majority of the respondents show that the lower demand for EVs in the U.S. is affected by inadequate environmental regulations and lack of sustainable goals, and this, in turn, is highly dependent on the president. As explained earlier, the president of the U.S. has a big impact on the environmental regulations of the country, therefore, the president will most likely impact the demand for EVs in the U.S. due to either enforcement or deregulation of environmental laws.

U2 Presidential Impact and U5 LIB Cell Ecosystem (0) The uncertainties of future presidential elections and if the ecosystem will be sufficient in the future are expected to be fully independent. It is not assumed that the outcome of future elections will have a direct influence over the development of the ecosystem for EVs or cell manufacturing. Also, the other way around is not assumed to consist of any dependencies. Hence, this correlation is marked absent.

U2 Presidential Impact and U6 Bargaining Power (0) It is not expected to exist a correlation between the uncertainty of future presidential elections and the uncertainty of who will possess the bargaining power in the battery industry in the future. Rather, these uncertainties are fully independent where the outcome of one does not affect the other.

U2 Presidential Impact and U7 Cells as Core Business (0) These two uncertainties are not expected to influence one another. The outcome of future presidential elections is seen to not be related to OEMs view on cell technology as a core competence. Instead, these two uncertainties stem from independent factors and decisions, hence, the correlation is neutral.

U2 Presidential Impact and U8 Human Capital (0) U2 and the uncertainty of sufficient human capital in the future is considered to have a neutral correlation. Neither of the respondents discussed a relationship between these uncertainties, nor is a relationship identified by the researchers.

U2 Presidential Impact and U9 Technology Risks (0) If a new president is elected or not does not have an impact on the technological risks OEMs are facing. Instead, these two uncertainties are independent as neither primary data nor secondary data mention a connection between them.

U3 Cell Manufacturing in the U.S. and U6 Bargaining Power (?) It is hard to determine if the development of cell manufacturing in the U.S. impacts the possession of bargaining power. The respondents mention that who possess the bargaining power in the future is highly influenced by the development of the battery industry. If cell manufacturing increases and results in a large supply of LIB cells, OEMs could gain increased bargaining power as it is high demand and the amount of cell manufacturers on the market increases. Contrarily, if cell manufacturing remains relatively low, the cell manufacturers could continue to possess the bargaining power as demand exceeds supply, however, the outcome is highly uncertain, and it might turn out differently. Hence, the two dimensions do not have an obvious correlation as cell manufacturing can affect bargaining power in both a positive and negative way, or not at all. Thus, the correlation is marked '?'.

U3 Cell Manufacturing in the U.S. and U7 Cells as Core Business (0) Respondents discuss that if OEMs start making the LIB cells themselves, they will probably only invest in one site globally and the chances of putting it in the U.S. is low. Putting up an own site implies a high investment cost. Also, economies of scale is not likely to be reached within the chosen time-frame. Hence, even if they start planning for cell manufacturing there is no sign of correlation between the uncertainties. Nor is it found in the data that increased cell manufacturing in the U.S. incentivizes OEMs to have cells as core business, thus it is other factors affecting that decision.

U3 Cell Manufacturing in the U.S. and U9 Technology Risks (?) The correlation between these two uncertainties are hard to determine. On one hand, the cell manufacturing in us might just lower the risks for OEMs since they might have the possibilities of switching between cell manufacturers if there are more players in the market, however, a big increase of cell manufacturers in US is highly unlikely and the respondents mentioned that there will only be few manufacturers with good enough quality for automotive. It is also highly uncertain whether or not OEMs will produce themselves, which could imply that cell manufacturing in the U.S. is a big technical risk for OEMs if they are the ones producing and technology changes. Anyhow, the correlation is set to be unpredictable and even if it might be a correlation it is hard to determine in which direction in goes.

U4 Demand in the U.S. and U6 Bargaining Power (0) Demand has to to with the willingness of customers to make a shift toward EVs whereas bargaining power has to to with whom of the OEMs and the Cell manufacturers that possess the capability of setting requirements. If demand increases it does not directly affect the bargaining power of either OEMs or cell manufacturers, at least not in the investigated time period. It was mentioned by respondents that in the future when there are enough suppliers and the technology is dispersed, demand will stagnate, and OEMs might get a higher bargaining power.

U4 Demand in the U.S. and U8 Human Capital (0) A relationship between demand and human capital could not be identified. There is no data indicating that increase in demand implies an increase in human capital, or vice versa. There is a lack of human capital and the development of it is highly uncertain, the same is with demand, it is highly uncertain in demand if EVs in US will take off. However, the positive correlation of cell manufacturing and demand together with the correlation of cell manufacturing and human capital could indicate an indirect relationship between Demand and Human Capital. This is highly uncertain and not something that could be determined here, thus the relationship was set to be neutral.

U4 Demand in the U.S. and U9 Technology Risks (0) Since the demand is depending on incentives in terms of environmental regulations, presidential elections, increased manufacturing of EVs, and a sufficient ecosystem there is nothing indicating that the technological risks of OEMs has anything to do with demand. Increased demand does not affect the risks for OEMs either, thus no correlation was identified in between the uncertainties.

U5 LIB Cell Ecosystem and U6 Bargaining Power (?). Whether the LIB cell ecosystem becomes sufficient depending on if OEMs or cell manufacturers hold the bargaining power is not possible to determine. Likely, however, it will be affected by the balance of power, why it is marked '?'.

U5 LIB Cell Ecosystem and U7 Cells as Core Business (?) A sufficient ecosystem might be convenient when having cells as a core competency, since starting an own cell manufacturing means that OEMs take a big risk when investing in a specific technology. During the interviews it was mentioned that a sufficient ecosystem could imply the development of standards in cell manufacturing, thus it might be an easier decision for OEMs to invest in cell manufacturing if the ecosystem was sufficient. However, this is only speculations and very hard to determine which leads to the correlation to be highly unpredictable.

U6 Bargaining Power and U8 Human Capital (0) As was just mentioned, having bargaining power in favor for the OEMs would imply that they could acquire human capital from the cell manufacturers, yet it would not create more or less human capital as that would be depending on other factors such as a sufficient ecosystem.

U6 Bargaining Power and U9 Technology Risks (?) Depending on who gets the bargaining power, the correlation could go into split directions. It is also hard to determine whether the risks would be higher or lower if the bargaining power was in favor of cell manufacturers. The data collection showed that if OEMs are dependent and rely on a small number of cell manufacturers, they face a big risk if technology changes. However, if the OEMs would have the bargaining power, it is likely that they could easily swap between suppliers, which would though call for enough suppliers to be available. Nonetheless, other factors also affect this correlation, so considering the unpredictability in this matter, the outcome of the correlation cannot be determined.

U7 Cells as Core Business and U8 Human Capital (?) If the trend points toward OEMs having cells as a core competence, there are chances of establishing unique competencies for the industry thus, it might be an increase in human capital. However, it is highly unpredictable to determine whether or not the OEMs will acquire good enough competencies to develop new human capital thus the correlation is unpredictable.

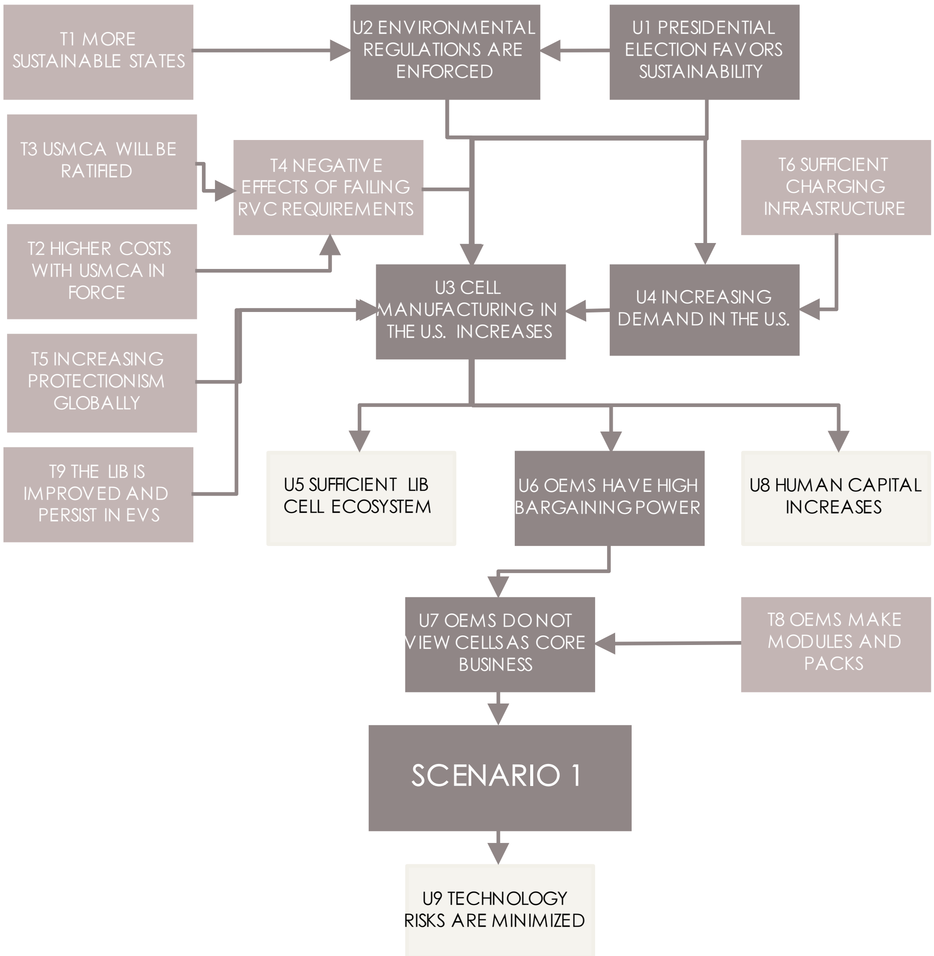
U7 Cells as Core Business and U9 Technology Risks (?) The idea of OEMs to have cells as core business is to secure the access of LIB cells, however, as mentioned, investing in a specific technology implies risks if technology or standards change. Whether or not having the production in house will lower the risks is hard to say, especially because there are several types of technology risks discussed by the respondents. Therefore, determining if the net effect of the risks is positive or negative by having cells as core business has not been obvious. Hence, the correlation is marked unknown.

U8 Human Capital and U9 Technology Risks (0) Whether or not human capital increases the technological risks for the OEMs stays the same. The other way around, if technological risks increase or decrease it has nothing to do with human capital since tacit competence might not be of help if technology changes completely.

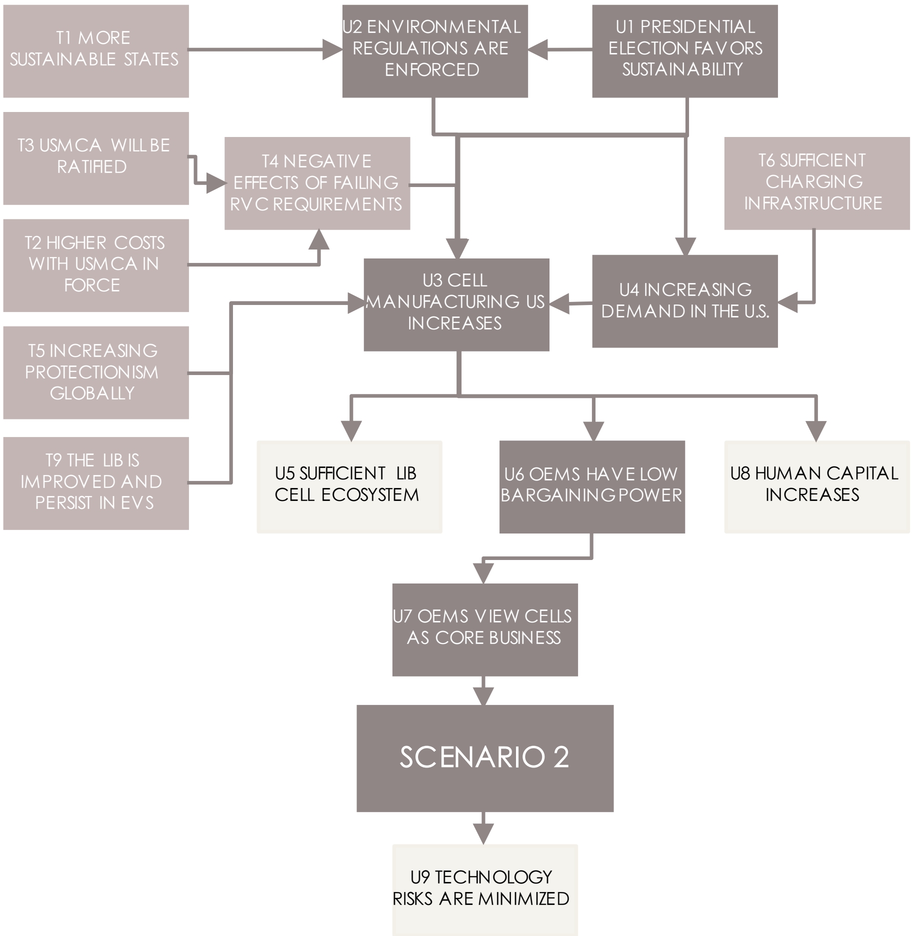
APPENDIX D

Influence Diagrams for the Four Scenarios

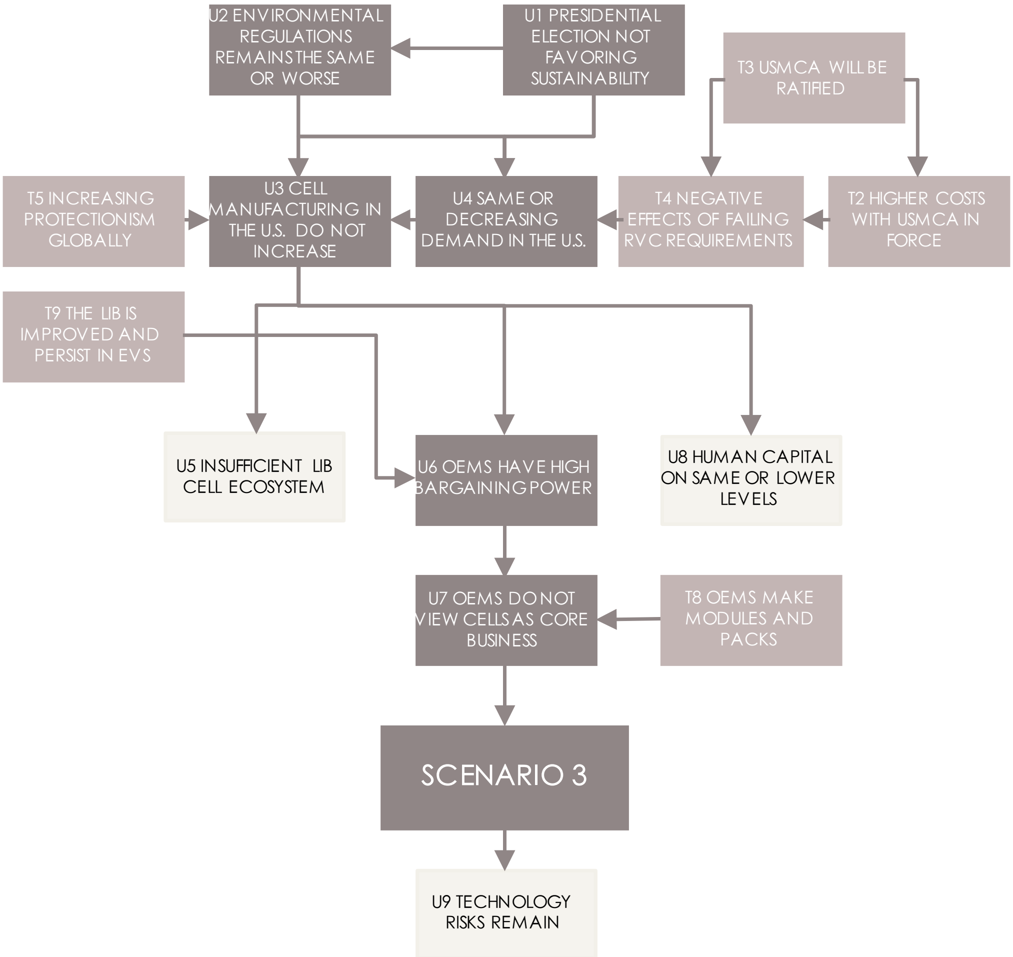
SCENARIO 1



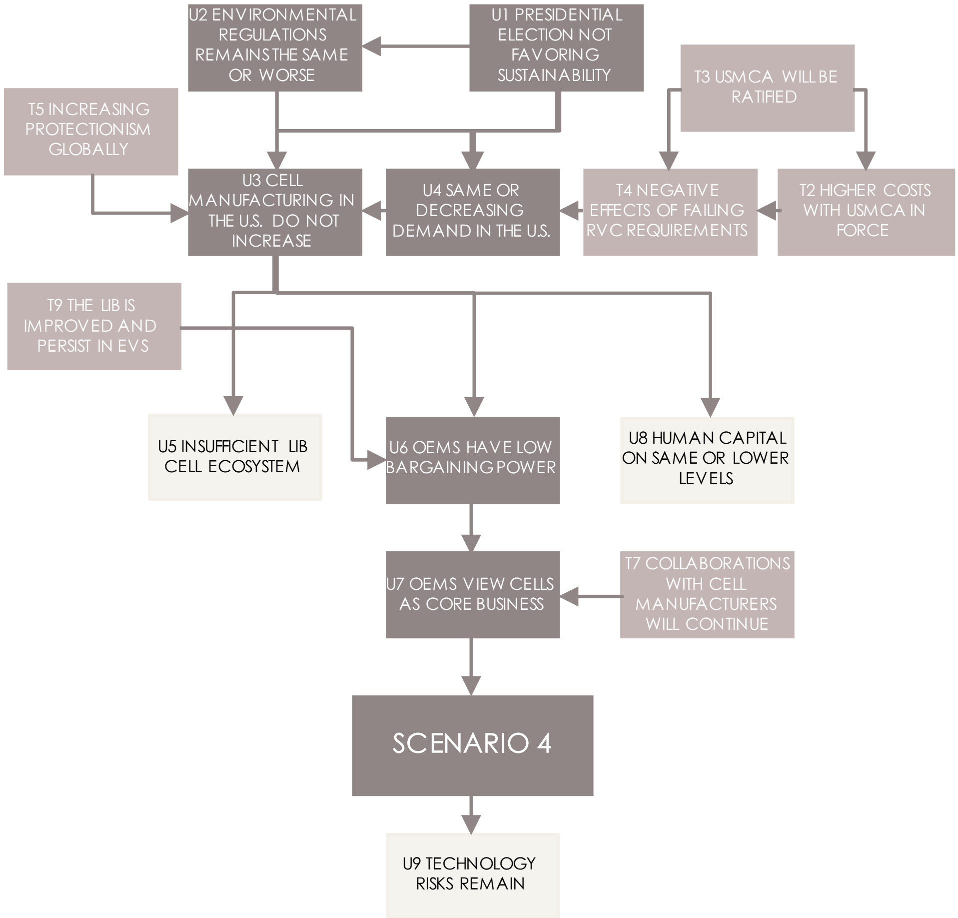
SCENARIO 2


T1 MORE SUSTAINABLE STATES
U2 ENVIRONMENTAL REGULATIONS ARE ENFORCED
U1 PRESIDENTIAL ELECTION FAVORS SUSTAINABILITY
T3 USMCA WILL BE RATIFIED
T4 NEGATIVE EFFECTS OF FAILING RVC REQUIREMENTS
T6 SUFFICIENT CHARGING INFRASTRUCTURE
T2 HIGHER COSTS WITH USMCA IN FORCE
U3 CELL MANUFACTURING US INCREASES
U4 INCREASING DEMAND IN THE U.S.
T5 INCREASING PROTECTIONISM GLOBALLY
T9 THE LIB IS IMPROVED AND PERSIST IN EVS
U5 SUFFICIENT LIB CELL ECOSYSTEM
U6 OEMS HAVE LOW BARGAINING POWER
U8 HUMAN CAPITAL INCREASES
U7 OEMS VIEW CELLS AS CORE BUSINESS
SCENARIO 2
U9 TECHNOLOGY RISKS ARE MINIMIZED

SCENARIO 3


U2 ENVIRONMENTAL REGULATIONS REMAINS THE SAME OR WORSE
U1 PRESIDENTIAL ELECTION NOT FAVORING SUSTAINABILITY
T3 USMCA WILL BE RATIFIED
T5 INCREASING PROTECTIONISM GLOBALLY
U3 CELL MANUFACTURING IN THE U.S. DO NOT INCREASE
U4 SAME OR DECREASING DEMAND IN THE U.S.
T4 NEGATIVE EFFECTS OF FAILING RVC REQUIREMENTS
T2 HIGHER COSTS WITH USMCA IN FORCE
T9 THE LIB IS IMPROVED AND PERSIST IN EVS
U5 INSUFFICIENT LIB CELL ECOSYSTEM
U6 OEMS HAVE HIGH BARGAINING POWER
U8 HUMAN CAPITAL ON SAME OR LOWER LEVELS
U7 OEMS DO NOT VIEW CELLS AS CORE BUSINESS
T8 OEMS MAKE MODULES AND PACKS
SCENARIO 3
U9 TECHNOLOGY RISKS REMAIN

SCENARIO 4


U2 ENVIRONMENTAL REGULATIONS REMAINS THE SAME OR WORSE
U1 PRESIDENTIAL ELECTION NOT FAVORING SUSTAINABILITY
T3 USMCA WILL BE RATIFIED
T5 INCREASING PROTECTIONISM GLOBALLY
U3 CELL MANUFACTURING IN THE U.S. DO NOT INCREASE
U4 SAME OR DECREASING DEMAND IN THE U.S.
T4 NEGATIVE EFFECTS OF FAILING RVC REQUIREMENTS
T2 HIGHER COSTS WITH USMCA IN FORCE
T9 THE LIB IS IMPROVED AND PERSIST IN EVS
U5 INSUFFICIENT LIB CELL ECOSYSTEM
U6 OEMS HAVE LOW BARGAINING POWER
U8 HUMAN CAPITAL ON SAME OR LOWER LEVELS
U7 OEMS VIEW CELLS AS CORE BUSINESS
T7 COLLABORATIONS WITH CELL MANUFACTURERS WILL CONTINUE
SCENARIO 4
U9 TECHNOLOGY RISKS REMAIN