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Establishing a battery manufacturing base in Sweden:

Evaluating and analyzing the factors behind locational strategy of battery manufacturers

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List of abbreviations:

EU - European Union

EIB - European Investment Bank

IB - International Business

OSCM - Operations and Supply Chain Management

EV - Electric Vehicles

Abstract

Background: In the last few years, many of the risks of operating in a global supply chain or an offshore manufacturing strategy have become evident as they have been disrupted by accidents, pandemics, and conflicts. Multiple parties in global trade have also increased their talks about autonomy in strategic sectors or production of strategically important components. The theoretical problem of current literature is that there is a lack of research on the strategies of the manufacturing bases that are of strategical importance of nations.

Purpose: The purpose of the study is to fill the theoretical gap by studying the factors behind the location decision which battery manufacturers consider when they decide to relocate production. Moreover, the study will explain the opportunities and implications that reallocating the production entails.

Method: The approach of the study will be a comparative case based on qualitative data to explore and create an understanding and explanation to the research purpose. The design of the research has been based on and inspired by thematic analysis and the cases has been chosen through a purposeful sampling technique. The main form of data collection of this research will be secondary data.

Conclusion: This study is increasing the understanding of reallocating battery manufacturing to Sweden. It adds to the existing literature in the field of IB and OSCM by the discovery of two new factors of opportunities behind locational decision. The first one was seeking municipalities with low permit process complexity in the due diligence process, and the second one was choosing a location that has possibilities for attaining more regional autonomy in material supply, as a strategic internal consideration.

Table of Contents

1 INTRODUCTION 5

1.1 BACKGROUND 5

1.2 RESEARCH PROBLEMATISATION 6

1.3 RESEARCH PURPOSE 7

2 LITERATURE REVIEW 8

2.1 LITERATURE METHOD 8

2.2 MANUFACTURING STRATEGIES 8

2.3 REALLOCATION OF MANUFACTURING 10

2.3.1 DUE DILIGENCE FAILURE 10

2.3.2 CHANGES IN THE EXTERNAL ENVIRONMENT 11

2.3.3 STRATEGIC SHIFT 13

2.4 RATIONALES BEHIND EUROPE'S STRATEGIC AUTONOMY 15

2.4.1 IMPLICATIONS WITH STRATEGIC AUTONOMY ON AN INTERNATIONAL LEVEL 16

2.4.2 IMPLICATIONS WITH CREATING A STRATEGIC MANUFACTURING BASE 16

2.5 PROPOSED THEORETICAL FRAMEWORK 18

3 METHODOLOGY 20

3.1 RESEARCH APPROACH 20

3.2 RESEARCH DESIGN 21

3.3 DATA COLLECTION 22

3.3.1 SOURCES USED FOR THE COMPANIES 23

3.4 SAMPLING 24

3.4.1 SAMPLING CRITERIA 24

3.4.2 CASE DESCRIPTIONS 26

3.5 VALIDITY AND TRUSTWORTHINESS 26

3.6 ETHICS 27

4 FINDINGS 29

4.1 BACKGROUND 29

4.1.1 BUSINESS ENVIRONMENT IN SWEDEN 30

4.2 NORTHVOLT SKELLEFTEÅ 31

4.2.1 MANAGERIAL DUE DILIGENCE 31

4.2.2 CHANGES IN THE EXTERNAL ENVIRONMENT 33

4.2.3 STRATEGIC SHIFT 35

4.3 NORTHVOLT BORLÄNGE 36

4.3.1 MANAGERIAL DUE DILIGENCE 36

4.3.2 EXTERNAL ENVIRONMENT 37

4.3.3 STRATEGIC SHIFT 38

4.4 NORTHVOLT TORSLANDA 38

4.4.1 MANAGERIAL DUE DILIGENCE 39

4.4.2 EXTERNAL ENVIRONMENT 39

4.4.3 STRATEGIC SHIFT 40

4.5 SCANIA 41

4.5.1 MANAGERIAL DUE DILIGENCE 41

4.5.2 EXTERNAL ENVIRONMENT 42

4.5.3 STRATEGIC SHIFT 43

5 DISCUSSION 45

5.1 DUE DILIGENCE 48

5.2 EXTERNAL ENVIRONMENT 50

5.3 STRATEGIC SHIFT 51

6 CONCLUSION 54

6.1 SUMMARY 54

6.2 LIMITATIONS 55

6.3 PROPOSED FUTURE RESEARCH 56

7 REFERENCES 58

1 Introduction

In this section the background of the situation in international business, manufacturing strategies and supply chain management will be provided. The European economy and the new concept called strategic autonomy will also be presented, and later on the research gap will be stated followed by the purpose of this research paper.

1.1 Background

Much has happened in the last three years that has shifted the terms of global trade. The outbreak of Covid-19 led to multiple countries shutting down which impacted output and lead-times in multiple supply-chains (Raza et al., 2021). In addition to the impact of virus, the global economy also saw the accident where a containership stranded in the Suez Canal which resulted in a day's long blockade of one of the busiest canals in the world. This blockade further impacted shipping prices and prolonged the lead-times of the international supply-chains.

What has happened in the world of international business is that companies and economies, like the European Union and the United States has realised their vulnerability to exogenous shocks and the great impact it has on the output of the economy. Furthermore, we have a digital and electric transformation of the global economy, which has increased demand on electricity, batteries and important components and materials needed for the EU to achieve their climate goals. This has impacted the context and view of international supply-chains in a way that companies have started re- and near-shoring important manufacturing processes. EU have also proposed as a reaction its own industrial plan with the aim to create a resilient supply chain. This is a plan that strives to bolster competitiveness, speed up a green transition into renewable energy sources and create a higher degree of strategic autonomy. The concept refers to a country's abilities to act independently, without having to rely on other nations to pursue its key objectives and goals.

This sheds light on very specific business environment in the context of EU, that little studies have had time to explore in depth yet. These are all relatively new phenomenon's that have gained high traction after the Russian invasion, and after new further lockdowns of major manufacturing and logistic hub such as Shanghai.

It is therefore important to increase the theoretical understanding of re-/nearshoring of these EU strategic industries in a new study.

1.2 Research problematisation

From previous research on manufacturing strategies, we know that reconfiguring value chains and establishing manufacturing bases with proximity has proven to be overrepresented in technology-intensive industries with high demands on quality, standards, and with the need for local adaptation (Ancarani & Di Mauro, 2018; Dachs et al., 2019). In addition, advancements in industry 4.0 technology such as automation, robotics, 3D printing have been another source of opportunities for local and regional production to grow. This has especially been the case in sectors with high R&D expenditure and which create a high added value-value on the end products (Kaivo-Oja et al., 2018; Bárcia De Mattos et al., 2021; McIvor & Bals, 2021). The automotive industry is a sector that is characterized by these features (Raza et al., 2021). Furthermore, the European Commission has addressed that the automotive industry is a very important sector to electrify to achieve the emission targets in the green deal and become a net-zero emitter by 2050.

Lippert et al. (2019) and Fiott (2018) examines the concept of strategic autonomy from a European defence perspective, but little to no research have been conducted in an industrial setting. The Russian military invasion in Ukraine has changed the European security order and shed further light on bottlenecks, shortages, energy supply concerns, and reputational cost with the current value chain setups. The long-lasting effects of both the Covid-19 pandemic and the current war in Europe entails a great deal of uncertainty and raises many question marks to examine (Hume, 2022; Borell, 2022; Gregior & Van Acker). The need for nations and business to build up manufacturing bases in strategic industries have clearly surged and been reinforced during the events of the recent months (Raza et al., 2021).

The European Investment Fund (2019) gave out 2 billion euros in financing for strategic investments in Sweden, in which a sizeable share went to funding for building up battery manufacturing. The country of Sweden has a large proportion of renewable electricity in its energy mix and has been ranked as the second most innovative nation (WIPO, 2021). Moreover, Sweden is also a country that is characterized by entry barriers such as high costs, high taxes, though permit processes and strict environmental protection policies (Engström et

al., 2018). These are some factors that are unique to Sweden and that consequently need to be evaluated in focused studies.

The theoretical problem of the current literature on manufacturing strategies in both EU and Sweden is the lack of new research covering reallocation of manufacturing processes that are strategically important to the country. The strategic autonomy concept as explained before, has long being highly criticised for discouraging free trade and world economic development (Young, 2021; Thompson, 2019), but have lately gained higher acceptance among researchers (Raza et al., 2021) as a phenomenon that both business and countries economically and environmentally gain from by approaching.

Barbieri et al. (2018) highlighted a theoretical gap around the decision-making and implementation process of locational strategies. They also contributed to a large convergence of much of the widespread manufacturing location theory of IB and OSCM down to three simple categories.

Therefore, by examining important factors and implications in the process of the locational decision, and during the establishment of battery manufacturing would add valuable understanding for both policy makers and businesses.

1.3 Research Purpose

The purpose of the study is to explain the factors behind location decision which battery manufacturers consider when they decide to relocate production to Sweden. Secondly, the study will explain the opportunities and implications that entails relocating production.

In addition, the study aims to understand how battery manufactures think, by both examining internal and external factors during the decision-making process of establishing a battery manufacturing base. This will be done by applying a qualitative approach.

To cover the purpose of the study, the key evaluation question to answer is: What factors have battery manufacturers considered when deciding to locate in Sweden?

2 Literature Review

This chapter starts with presenting the keywords and methodology used to review the literature. It begins with a general assessment of manufacturing strategies. Thereafter it evaluates the current literature of drivers, introducing the reader to the context of EU's industrial objectives towards strategic autonomy, and ends with a review over the challenges and implications of strategic manufacturing domestically.

2.1 Literature Method

This paper aims to expand the knowledge of the topic by combining keywords such as "Manufacturing Strategies", "Sourcing strategy", "Reshoring", "Back-sourcing", "Near-shoring", "EU's Strategic Autonomy", "Self-sufficiency", "Resilience". This was done by examining relevant and recent articles on multiple search engines including Google Scholar, SCOPUS, EBSCO and Jönköping University's own library database.

The quality of the reviewed literature in terms of articles, book chapters, published texts and journal have been carefully evaluated based on the amount on citations but also on its reputation in the field of IB and OSCM. To achieve this the ABS journal list was useful for easily checking the publishers rating.

The reviewed literature was transcribed into a Microsoft Excel template where name, year, keywords, findings, limitations, and comments are displayed. This technique is known as a type of synthesis matrix. This allows for getting a good overview of the main ideas, discover similarities and be able to compare them with differences (Ramdhani et al., 2018).

Mackieson et al. (2019) explained in his research how to reduce bias in qualitative studies, and to comply with his findings this paper had the authors write down the transcribed versions of all articles into a document to see if the conclusions and findings in each article would be the same. Thereafter each author reviewed different literature individually.

2.2 Manufacturing Strategies

The first research regarding manufacturing strategies (Smith, 1778; Ricardo, 1817) founded the economic theories that production was decided and influenced by concepts of

specialization and comparative advantage. Later, the Heckscher-Ohlin model found that manufacturing is located depending on labour productivity and relative abundance resources and capital (Jones, 2018). The model builds on the Ricardian model and aims to predict patterns of production and trade based on the factor endowments of a trading region. Essentially, the model states that countries focus on production of products which use their relatively abundant and cheap factors of production and import the products which use the countries' relatively scarce resources. However, more recent literature has found that production location is determined based on more factors than resource abundance and prices. Today we know that location of production and manufacturing is influenced by multiple factors, where the primary are quality, costs, innovation, dependability, and sustainable performance (Frick, 2017). In their paper, and Netland investigated these factors and how the changes of priorities in competitive manufacturing strategies of European companies had changed through 1997 to 2017.

According to Ward et al. (1998), companies must prioritize its competitive strategies as time and resources are not abundant and therefore companies create strategies to define how they allocate their capabilities.

In their paper, Netland and Frick found that that there were 5 prominent trends that appeared. Firstly, firms showed that they still believed that quality and dependability were of the highest priority to compete successfully against other firms. The second trend that the authors identified was that cost priority was the most relative fluctuating priority between 1997 and 2017, and they spotted that cost priority was the highest when GDP had fallen for two years in a row, while priority was low at times of economic development.

More importantly, trend 3 and 4 that Netland and Frick found was that speed, flexibility and innovation were much higher priorities for firms in 2017 than it was 20 years prior. The 5th trend indicated that sustainability had not continued its relative increase as a competitive priority. The authors suggest that, though this finding is surprising and perhaps disappointing, it is possible that the relative decline can be explained. They speculate that many of the sustainability issues that firms priorly regarded as competitive advantages are today legislated in European law. Therefore, the firms are obligated to follow the sustainability practices rather than viewing them as a competitive priority to allocate capabilities to.

To manage all the current strategies related to manufacturing, Aboutalebi (2017) conducted a systematic literature review of all the publications related to manufacturing strategies and thereafter create a taxonomy of the identified strategies. Aboutalebi found that strategies revolve around location and the type of producer. Based on the analysed literature, the researcher found that location of manufacturing can be offshore, near-shore, reshored, or a combination of the beforementioned which make cross-shoring. Regarding the type of production, it can be made in-house, outsourced or in and out.

2.3 Reallocation of Manufacturing

In addition to Aboutalebi's (2017) findings, Bals and McIvor (2021) studied the motivations to why firms choose to re- or near-shoring production. They found that it is a combination of governance, external, and strategic considerations. Manufacturing decision is a topic that have been discussed by both academics in international business and in operations and supply chain management. Both fields identify similar conclusions of what drives reshoring of manufacturing but emphasizes different weights on certain parts. To facilitate a holistic overview over both fields of research but to still make it distinctly to follow, Barbieri et al. (2018) has identified three main categories that will be used recurrent throughout the study. These three categories are due diligence, changes in the external environment, and strategic shifts. Barbieri found evidence that reshoring can be characterized as either a reaction to changes in internal and/or external conditions or as a correction of previous misjudgement of the feasibility of business opportunities or strategic considerations.

2.3.1 Due Diligence Failure

Due diligence is originally a word for analysing transactional business or investment choices. It relates to do an assessment and evaluations of risks, credibility, and opportunities (Harvey, 1995). For this paper it is helpful for describing the process mangers does before changing manufacturing strategy. The first category of Barbieri et al. (2018) is suggesting that it may be the result of a failure to evaluate the entire offshoring opportunity correctly (Kinkel**,** 2014; Ashby, 2016; Foerstl et al., 2016; Albertoni et al**.,** 2017). Thus, this shows that a reason to reconsider the choice of location is due to a lack of management ability to effectively carry out due diligence before the decision on offshoring is decided. For example, its hidden costs, profitability, market opportunity, labour efficiency, the total investment needs may have been underestimated or miscalculated.

However, the managerial failure cannot in isolation be derived to only those physical factors. The decision to change the value chain can be triggered by quality issues, implications in governance, poor management, or communication difficulties with a more intangible character. Coordinating and monitoring activities in long value chains have been described as much more complex across linguistic, cultural and time zones (Wiesmann et al., 2017).

Covid-19 shed light on bottlenecks, lead-times, and escalating costs of transportations corresponding to a more ecological cost of supply chain setup. This has severely influenced the number of offshoring failures and made the process of forecasting coordination and operating expenditures significantly more difficult (Raza et al., 2021).

2.3.2 Changes in The External Environment

Another category of reallocating manufacturing is changes in the external environment. Much of this category can still be explained by classical international trade theory. Where countries' relative input factors, comparative advantages, abundance of resources and resource-based perspective are explanatory variables for the pattern of trade (Smith, 1778; Ricardo, 1817; Jones, 2018).

However, the market rarely appears under perfect competition nor freedom from government interference. Dunning (1980) and Porter **(**1994) contributes with important insight of these market inefficiencies and discusses how presence in industrial clusters, or the use of production-, transportation-, information- and communication- technology can lead to positive externalities. Professor Alfred Marshall had previously identified these competitive advantages as internal and external economies of scale. These findings are important to consider in understanding corporate reshoring and nearshoring choices of strategic industries for regional independence.

Another insight from the trade policy theory is that the gain in national welfare have been described as somewhat lower for advanced economies than for less developed countries by opening for more trade (Krugman et al, 2018). This can incentivize leaders to adopt protectionist policies. Trade protectionism is the actions of governments where they intervene in free trade through the introduction of economic policies such as tariffs, quotas, or subsidies to promote domestic exports, jobs, and production in sectors of strategic interest (Ruggie, 1994). These changes in interventions or the introduction of incentives can be strong drivers for reconsidering the offshoring decision (McIvor & Bals, 2021).

Beyond the government interventions and the whole assessment of the political risk a country has, some of the most important factors that is highlighted in the IB literature for location sourcing decisions. It has to do with the overall condition in the global economy but also factors associated to the host county. With the global environment in mind, the stage of the economic cycle, degree of inflation, interest rates or if the monetary policy's set by central banks is expansionary of contractionary plays an important role. Furthermore, it also matters how the mood on the financial market is, and how easy or difficult it may be to raise long-term or short-term capital or debt financing. At the domestic level, differences in wage levels, labour force, productivity, currency stability, energy costs, access to natural resources, material, public-, logistical-, financial infrastructure is described as key host country factors (Srai & Ané 2016; Engström et al., 2018; MC Ivor & Bals 2021).

Another challenge that has reinforced the phenomenon of reshoring strategic industries to the EU is the protection of intangible business assets and maintaining internal knowhow. Widespread value chains have made it much more difficult to control whether the intellectual properties rights are respected. Ashby (2016) describes how the view of copyright differs in different parts of the world, and how reshoring in that sense can reduce the risk of piracy theft and enhance innovation in high value-added sectors.

Engström et al., (2018) conducted research about drivers behind reshoring from a Swedish perspective and examined different industries. They found that the case companies' abilities to achieve quality was a major driver. Creating quality is highly connected to the host countries resources and infrastructure, but also to more capacity- and supply chain-oriented perspectives that not always are easy to quantify cost and benefits on. This leads us to next important category of driver.

2.3.3 Strategic Shift

The third and final category behind reconsidering one's manufacturing strategy is addressed in (Ellram et al., 2013; De Backer et al., 2016; Baraldi et al., 2018; Engström et al., 2018; Stefano & Fratocchi, 2019) research. They go one step further than what is explained by the external cost-related theories and emphasizing that reshoring can be due to internal characteristics, or as mean for pursuing a competitive strategy.

One thing they brought up, among other things, is that customers' expectations of quality, flexibility and sustainability requirements are dynamic and have changed in recent years. These insights can therefore be important reasons why some companies place manufacturing closer to customers. Admittedly, these findings align with what Bartlett and Ghoshal (2002) have already developed international strategies for and described as local responsiveness.

Another opportunity that has both been both criticized and praised among scholars is the "Made in" effect. In its simplicity, this effect means that labelling the country of origin on a product may be a competitive strategy and make people willing to pay premium prices. Thereby, the phenomenon can be described as an incentive for manufacturing in one certain country, if it entails a competitive advantage (Piatanesi & Arauzo-Carod, 2019). In a recent study by Fratocchi and Stefano (2020) they surveyed companies that have backshored to Europe to automated facilities. They found Country-of-Origin effect was ranked as the second most important motivation behind their decision. De Backer (2016) also evaluated the reputation effects and concluded that relocation of production tends to create extra value in the form of positive publicity for the company if pursuing that strategy. However, not all researchers seem to agree, and it tends to depend on the types of products that are manufactured. In another study conducted by Fratocchi et al. (2021) within the footwear industry, the "made in" effect did not show a statistical significance for the location decision of production.

Advances in cloud computing, 3D-printing, artificial intelligence, robotics and automated manufacturing processes are something in advanced economies that have been claimed to be a major driving force for returning manufacturing processes. This is commonly referred to as Industry 4.0. These advancement in technology has begun to gain momentum during the pandemic and increased the incentives for domestic production (Seric & Winkler, 2020), but there is no consensus among scholars. Bárcia De Mattos et al. (2021) was evaluating whether

the automation trend in the clothing industry was changing the labour intense industry to being reshored or nearshored. Their conclusions could not find any indications that automation where driving reallocation back to domestic countries on a broader scale. Ancarani and Di Mauro (2018) are deriving a similar conclusion but argue that it depends on both the industry or the company's demand for customization and the need for innovation. This guides us into sectors that are characterized by adding higher values and that need to comply with local standards and preferences. The transportation industry is according to Raza et al. (2021) one such sector that will be more affected by advancement in industry 4.0 technology. In Dachs et al. (2019) quantitative research they are also supporting this statement and finding a higher correlation between reshoring among technology intense companies.

On the other hand, Butollo (2021) says that it is hard to even make inferences over whole industries since different technologies have different importance for specific companies. Furthermore, Butollo argues the improvements in technologies can both converge the length of value chains in some respects as well as increase it in another. Nevertheless, the use of robotics and automation in low-margin industries with high standardization is not viewed as reason for back shoring or building up strategic manufacturing domestically (Kaivo-Oja et al., 2018; Bárcia De Mattos et al., 2021; McIvor & Bals, 2021).

At a supply chain level, there are also many other internal considerations that cannot either be explained by the resource-based and external international business theory. For example, in technology-intensive industries. It has been argued by Bals et al. (2016) and Wiesmann et al. (2017) that a close distance to research and development can empower the company's ability to innovate, but that is only one strategic consideration. The connections between supplier and productions processes are also important opportunities and Di Mauro et al. (2018) described these relationships as interdependencies. The degree of internal coordination and interdependencies are however often sector specific and therefore, the advantage of using these opportunities for synergies will be of varying importance when making decision of manufacturing location (McIvor & Bals 2021).

Recent research found that typically, near-shorers are larger than the reshoring firms and this may be explained by the fact that larger firms can afford to take higher risk (Fratocchi et al., 2021; Rasel et al. 2020). Government aides contributed but were not the main decider when considering near-shoring or reshoring, instead the availability of knowledge and skilled

workers and possibilities to re-develop production sites were considered critical (Ellram et al., 2013).

2.4 Rationales behind Europe's Strategic Autonomy

According to Raza et al. (2021), China accounted for a third, and Asia Pacific for 41% of the world's global export. What at first was considered moving out manufacturing processes of basic low value-added, to the countries with the lowest cost of production have gradually developed towards offshoring higher value-added manufactured goods. For example, according to an article in New York Times by Barnes (2022), he explains that 90% of the world's most sophisticated chips are being produced in Taiwan. However, it is not just chips, East Asia and Pacific Region are today leading exporter of machines, electronic equipment, semi-conductors, critical commodities, and lithium-ion batteries used in electric vehicles.

The Covid-19 pandemic that limited the mobility of both goods and people worldwide have exposed the vulnerability of today's global value chains with relying on security of supply from a few countries. The global yearly risk report from world economic forum (2022) highlights the likeliness of extreme weather events and failure to tackle climate change as two of the top five global risks for the following years. The geoeconomic confrontation was only considered to be a top 10 risk. The vice president of the European Commission (2022) explains how the geopolitical rivalry among the big superpowers has clearly taken a large twist as Russia have started war with Ukraine and threatens the European security order, food-, energy supply. The size of the adopted economic sanctions and exclusion of Russia from the international banking payment system have causes many companies to quit manufacturing and trading with Russia. It has raised concern about reputational costs with relying on autocratic regime for trade and business activities (Borell, 2022).

A concept in EU that have gained high traction in response to the above-mentioned trends is strategic autonomy. It has to do with a country's abilities to ensure it can act independently and without having to rely on other nations to pursue it key objectives and goals. The expression originates from the security and defence perspective (Fiott, 2018), and was already back in 1985 described by Bailyn in an industrial setting of creating autonomy in R&D activities. Despite that, not many studies in the world of business have addressed it any further. Although its importance in business contexts for dealing with future exogenous

shocks, reducing dependencies on energy and critical raw materials only has gained momentum in recent developments (Raza et al., 2021; Van den Abeele, 2021).

2.4.1 Implications with Strategic Autonomy on an international level

Järvenpää et al. mentions in their report published in 2019 that one of the major issues with academia and research regarding strategic autonomy in Europe is that it has a lack of clarity about the true meaning of strategic autonomy. The author states that the lack of clarity has overshadowed the debate about this subject, and it has then set unrealistic expectations for what is possible. Furthermore, the word 'strategic autonomy' is widely regarded as a buzzword, and if people are to take this area more seriously, research will need to shed more light on its importance. Other articles by Lippert et al. (2019) and Fiott (2018) both states that there are major issues with Europe's defence capabilities regarding strategic autonomously, however the authors do not discuss how strategic autonomy is used in manufacturing or in industrial settings.

In the context of the European Union. Which is the highest form of preferential trade zone, with 27 countries sharing a political, social, and economic objectives. There are arguments that explain why the concept may have been excluded from the business literature. Youngs (2021) argues that it is very protectionist to strive for complete autonomy for manufacturing and that it disadvantages fair competition outside the Union's borders, and that it reinforces trade war tensions (Thompson 2019).

In response to this criticism, the European Commission often referring to "open strategic autonomy". With ambitions to still participating in international trade and cooperation but to reduce strategic dependencies in both defence, strategic industries, and critical supplies which are needed to pursue EU's long-term objectives (Van den Abeele, 2021).

2.4.2 Implications with creating a strategic manufacturing base

In recent literature reviews, Weismann et al. (2017) found that the main implication for reshoring activities is the importance of being careful and thoughtful when first considering offshoring or reshore production. The researchers found that decision to reshore is often a reaction to a quick and hasty offshoring decision. Moreover, the literature review explains that those decisions regarding reshoring needs to be considered as ongoing problems with current offshore production, and carefully analyse and address what the current issues are.

Weismann et al. (2017) goes on to explain that many drivers of the reshoring phenomena can be found in the supply chain, and managers will need to consider if these problems will also be addressed by reshoring their production. Another implication that is discussed by Weismann and his colleagues are that managers who are considering to offshore/reshore may take a decision that in the long run will have negative effects on the production and the supply chain, and these issues may be difficult to reduce in the future.

Fratocchi et al. (2016) also found that identifying the true reshoring motivations can be difficult, but also that trying to find the hidden costs with reshoring can be difficult to see and find beforehand. The article goes on to explain that moving the production home or to a nearby area (nearshoring), may end up eroding the companies' capabilities if the reshoring activity is not carefully examined beforehand. This is mainly due to unseen costs, but also other implications such as not having the correct expertise and/or human capital.

Engström et al. (2018) conducted a literature review and a case study where they examined the main drivers and barriers of reshoring activities, and their main findings for the barriers was capacity, calculations, and labour market in the home country. They also explained that they identified three new barriers whilst looking at their four case companies, and these new barriers were labour in host country, supplier partnership and ownership of product blueprints.

The literature around weather advancement in technology is driving companies to reduce their value chain length or not, is mixed. From previous drivers section there seemed to consensus around that competitive and research intense companies, that must comply with tough standards and meet consumer preferences are more likely to utilize advances in technology to manufacture closer to headquarters (Dachs et al., 2019; Seric & Winkler, 2020; Raza et al.,2021). However, according to Butollo (2021) that is an oversimplified conclusion. Butollo suggest that advancement in digital business infrastructure as seen during the pandemic, can reduce the cost of travelling, governing, and monitoring offshored activities. In Fratocchi and Stefano (2020) large survey of European companies. They highlighted this as one of the most important motivation and reason why companies are changing location back to Europe. The rationale of Butollo's argument is that in some situations advancements of technology have the opposite effect. It can both reinforce or slow down value chain integration, depending on what technology that is being adopted and in what sector they operate in.

2.5 Proposed theoretical framework

Manufacturing decisions is a hot topic that have been thoroughly discussed by academics of both international businesses, as well as in operations and supply chain management. These areas share common attributes and drivers of reconfiguration of manufacturing; however, the two different areas seem to emphasize different parts of the literature as the more important ones, and vice versa.

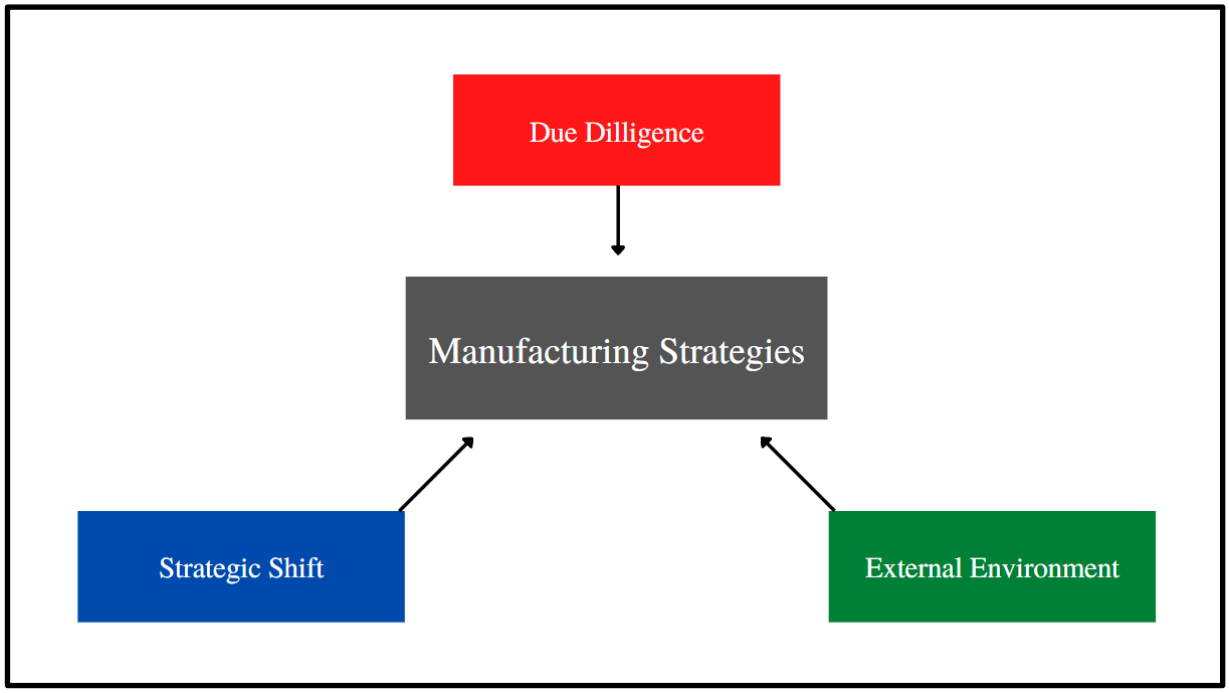
The available research of factors, implications, and opportunities with establishing a strategic manufacturing base in Sweden is highly limited. Studies conducted by Weismann et al. (2017) has made some findings in the area, however they looked at Europe as a whole, and not only on Sweden as this paper aims to do. Therefore, our proposed framework will include factors behind establishing a manufacturing base, but also the main opportunities and implications that follows when trying to create this strategic manufacturing base.

Recent studies made my Barbieri et al. (2018) identified three main categories within the manufacturing strategies, and these are due diligence, changes in the external environment, and strategic shifts. These categories, or factors, will be present in the framework as they are the most relevant studies and areas when establishing a manufacturing base.

The aim of the framework is to establish a theoretical perspective and analysis of the main factors, implications and opportunities when establishing a strategic manufacturing base in Sweden as seen in the model below (figure 2). This is done by connecting all the above given outcomes with the three categories which is strategic shift, managerial due diligence and external environment. This will be used throughout the whole paper, and primarily in the findings part where we will link this model to the available data for each different company that we aim to investigate further. This is done to gain a deeper and more clear understanding of the company's strategic manufacturing establishment.

Figure 2

Theoretical Framework Model



Note. A framework model that was created by Helenefors, Jakobsson and Uldin (2022) to apply the findings of the paper to the research question.

3 Methodology

The purpose of the methodology is to introduce the approach and design of the research as well as the reasons to why they are suitable for the research purpose. Secondly, the data collection will be addressed, and the sampling method and criteria will be stated. Lastly, the authors will address the issues of validity and ethics of this study.

3.1 Research Approach

As previously stated in the research purpose, this study aims to find and explain the factors behind the strategic decision of location as well as explaining the opportunities and implications that relocating production entails.

The approach of the study will be a comparative case study of four battery manufacturers that have production of batteries located in Sweden. Using a case study enables an in-depth examination of a single case and a comparative case enables the study to cover four cases in a way that emphasize the analysis of the similarities and differences of the different cases.

According to Goodrick (2014), a researcher from UNICEF's office of research, a comparative case study can be selected in a study when there is a need to understand and explain how features within a context influence process or the success of undertaken initiatives. Goodrick says that conducting a comparative case study involves analysis of the similarities, differences, and patterns across multiple cases that share a similar context for example. As the purpose of the research is to explain and explore, conducting a comparative case study is therefore suitable to create an understanding and explanation of the factors and to why the four cases has chosen to locate production in Sweden.

As the findings and evidence is presented later in chapter four, the features and characteristics of each case will be described in depth to create an understanding of them. As Goodrick points out, an understanding of each case is important to establish the foundation for the analysis and the framework which will be used in the cross-case comparison.

Both qualitative and quantitative data is often used in comparative case studies. The quantitative data in comparative case studies is often used to examining causality to understand what effects different interventions, factors and/or strategic choices has had on the

outcome of the different cases while the qualitative data is used to describe, explain and understand meanings of situations or events (Goodrick, 2014; Leavy, 2020).

As Maher and Dertadian (2018) concluded in their article that the qualitative research approach has gotten more popular throughout recent years. During the 1980's aids epidemic qualitative studies were conducted to further understand the topic and the process, so Maher and Dertadian claims that this was the reason for qualitative research to rise in popularity. Furthermore, they claim that qualitative research is used to detect, understand, and prevent events within the research area. This ties together with what Goodrick wrote on the subject; qualitative studies are made with the purpose of understanding the process, not necessarily solving it.

The central focus of this study is to uncover and understand the underlying factors of the process, rather than looking for causality or correlations. Therefore, this research will be conducted using qualitative data. For the analysis, this implies that the data will be divided to themes and categories.

3.2 Research design

The design of the research has been based on and inspired by thematic analysis. The phase of a thematic analysis enables a systematic way of seeing and processing qualitative data (Braun & Clarke, 2006; Nowell, 2017). There are five different phases in the process of using a thematic analysis and those are data familiarization, initial coding, thematization, reviewing themes and finally producing the report.

As this study will adopt a thematic analysis, the first step of the data analysis was to get familiar with the data. This has been done by transcribing and re-reading the data. Thereafter the data was coded in a systematic way to find features in the data that were evidence for certain characteristics or ideas in the cases, and these codes will then be thematized. Searching for themes in the data allows focus on the theoretical phenomenon that is being studied and enables the study to gather more data that is relevant to each theme.

Adopting a thematic analysis in the research design allows the study to find categories and identify similarities, patterns, and relationships of themes between the cases analysed, thereby enabling the finding of a theoretical explanation of the phenomenon (Braun et al., 2006).

In this paper, the strategic autonomy concept will only be considered from an industrial perspective, meaning how the EU has stated an aim for autonomy in sectors and of components which they see as vital for the modern economy. Due to the scarcity in earlier research of combining manufacturing strategies with the strategic autonomy context in Europe, the design of the study will be of inductive nature and seeks to develop connections of these two concepts along the way rather than testing an establish hypothesis. Furthermore, the gathering of empirical data will be supported with various sources of manufacturing strategy literature and displayed in a structured manner below in data collection and discussion.

This research design is suitable for conducting qualitative research as it allows a combining of IB and OCSM literature to explore new insights to the existing work. The research question is designed to understand, explore, and explain the factors, opportunities, and implications that battery manufacturing companies in Sweden face. The case companies have purposefully been selected through three specific criteria's that will be discussed soon.

3.3 Data Collection

In a report from UNICEF's office of research, Goodrick (2014) explain that comparative case studies often use mixed methods of data collection, integrating both qualitative and quantitative data. Whereas some mixed method evaluations use qualitative and quantitative data to answer different evaluation questions, in comparative case studies this data is analysed together with the intention of gaining an in-depth understanding of the cases. In addition, the use of mixed methods is purposefully adopted to understand and test causal propositions. However, this is not the case for all comparative case studies, as this is most often used in studies that aim to uncover causality or outcomes of different strategies or interventions and not for research approaches aimed at exploring, describing, or explaining a phenomenon (Goodrick, 2014; Leavy, 2020). As analysis of causality and outcomes is not the purpose of this research quantitative data analysis is not included.

The main form of data collection of this research will be secondary data where we will investigate news publishing's, interviews, conference report from industry organisations and financial reports from public companies. The data collection will include data from both Swedish and English sources as including data from multiple languages benefit the global

academic community (Abfalter et al., 2020). As Abfalter et al. argues research in the source language which is Swedish for this study can benefit the quality and value of the findings.

Technical advancements have led to large data sets being collected, which makes them easily accessible for researchers. As a result, researchers are more frequently using secondary data for their data analysis (Johnston, 2017). Secondary data has proved to be a valuable approach for research to find relevant and suitable data (Serra et al., 2018).

The translation of the data can take place at different times during the research process (Santos et al., 2015) and for this study the data was translated during data collection.

3.3.1 Sources used for the companies

Table 3.1

Table of Sources

Company/Collaboration	Type of Source	Authors	Publication Date	Name of Paper/Publication/Source
Northvolt Skellefteå	Interview	Sveriges Radio P1	2021-07-28	Peter Carlsson - Företagsledaren om att försöka bygga världens grönaste batteri.
	Interview	Research Institutes of Sweden	2021-07-06	Katarina Borstedt- Northvolt ställer om en hel stad.
	Interview	NyTeknik	2022-03-25	Så lyckades Northvolt gå från ord till färdig batterifabrik
	Article	Regeringskansliet	2021-02-11	Stöd till svenskt deltagande i europeiskt projekt för innovativ och hållbar batteriproduktion i EU
	Website Articles	Northvolt	2017-2022	N.A
Northvolt Borlänge	Interview	SVT	2022-03-21	"Vill inte ha fusk" – Northvolt kapar leverantörskedjor i Borlänge
	Article	Dagens Nyheter	2022-02-25	Northvolt mångmiljardsatsar på batterier i Borlänge
	Article	ViBilägare	2022-02-25	Northvolt ska öppna ännu en fabrik – nu i Borlänge
	Article	Fastighetsvärlden	2022-02-25	Northvolt etablerar sig i Borlänge – tar över Kvarnsveden
Northvolt & Volvo Cars Torslanda	Pressrelease	Volvocars	2022-02-04	Volvo Cars och Northvolt snabbar upp övergången till elektrifiering med ny batterifabrik som skapar 3 000 nya jobb i Göteborg.
	Commentary	Sverigesradio	2022-02-19	Snokar och fladdermöss kan stoppa nya batterifabriken – Volvo söker dispens
	Article	Investingothenburg	2022-02-15	WHY GOTHENBURG WAS CHOSEN FOR THE BATTERY GIGAFACTORY
	Article	Investingothenburg	2022-03-01	HOW THE BATTERY PLANT ENDED UP IN GOTHENBURG
	Pressrelease	Northvolt	2022-02-04	Volvo Cars and Northvolt accelerate shift to electrification with new 3,000-job battery plant in Gothenburg, Sweden
Scania Södetälje	Video	Rejlers Play, Youtube	2020-11-27	Scanias jättesatsning på lastbilsbatterier (Scania on implementing truck batteries)
	Webpage	Scania	2021-12-21	Scania's commitment to electrification – our initiatives so far
	Webpage	Scania	2020-11-17	Scania investerar i batterifabrik i Södertälje
	Webpage	SVT Nyheter	2021-02-09	Här startar Scanias batterisatsning i Södertälje – ska bli 200 tjänster
	Report	Scania	2022-03-11	THE SCANIA REPORT 2021: Annual and Sustainability Report
	Article	Bussmagasinet	2020-11-17	Scania miljardinvesterar i batterifabrik

Note. Collection of the key sources for the data collected about the cases.

As seen above in table 3.1 all the sources that are used for each case company is presented. This is done to keep the text in the discussion and finding's part cleaner and easier to read. By listing the sources in this way, the reader is also able to quickly see the sources. This also enhances the validity of the research as it is easy for the reader to double check that the sources are valid, and that they are relevant to our claims and conclusions. By listing the sources, we are also able to see where our sources origin from, which is articles and interviews with representatives from the companies.

3.4 Sampling

To make findings that are relevant to our research question, some basic yet essential criteria had to be defined prior to the search for case companies. Establishing these criteria's prior to starting the research and data collection is an important factor which means that less time must be made on looking for unnecessary data or information that would not be applicable to the research question. By looking at the research question and the research purpose, this paper found it easy to quickly establish some main points that needed to be discussed and researched, which in turn would mean that more time could be assigned into looking for relevant research, as well as searching in the available data and information channels for supportive claims and data.

The empirical data was collected from four cases chosen based on the concept of purposeful sampling identify and cases related to the phenomenon of battery manufacturing. A purposeful sampling of cases allows the research to choose and focus on subjects with experience of the exploration and decision-making in the process of establishing manufacturing operations (Engström, 2018).

3.4.1 Sampling Criteria

After this initial look-through of the research question, this paper found that there are three main criteria that needs to be selected and looked at to compare and analyse the four case study companies, which are presented below.

3.4.1.1 The companies need to be operating in the battery industry for electric vehicles

As this paper aims to understand and evaluate the factors, opportunities, and implications with establishing a battery manufacturing base in Sweden, it is essential that the cases that will be compared are all operating within the battery industry. It could also be that the company have

commitments of relocating their manufacturing process to Sweden. However, the four case companies that this study will compare are all in the process of establishing their base in Sweden as of right now.

To educate and add to the existing literature regarding establishing a manufacturing base in Sweden, this was one of the core principles that was required. Moreover, since our case companies are all operating within or close to the manufacturing of batteries in electric vehicles, all the cases had to be active in this specific area.

3.4.1.2 The company's geographical location

Choosing companies that are operating within Sweden was also an essential criterion as it fits our research purpose and research question. The paper examines four different case companies, all of which are in different parts of Sweden. The cases are in Torslanda (Gothenburg), Borlänge, Södertälje and Skellefteå which implies that we cover different locations and areas within Sweden.

3.4.1.3 Available data and research

Seeing as these ongoing projects with establishing battery manufacturing bases in Sweden are as large as they are, means that there are national news and people all over Sweden is talking about it. This means that getting in touch with the people responsible for making these projects happen, or even to get in touch with people within the projects, is a very difficult task. As previously discussed, this paper did not include any interviews with the case companies, for reasons just listed.

This implies that there had to be available research and data about each case, otherwise there would not be anything to add to the existing literature nor anything to discuss in this paper.

3.4.2 Case descriptions

Table 3.2

Case description

Company/Collaboration	Type of Manufacturing Strategy	Geography	Ownership	Type of Investment
Northvolt	Vertical Integration	Skellefteå (Northern Sweden)	Private Owned	Start-up
Northvolt	In-house Reshoring	Borlänge (Central Sweden)	Private Owned	Brownfield
Northvolt & Volvo Cars	In-house Reshoring	Torslanda (Western Sweden)	Multi-national Corporation	Joint Venture
Scania	In-house Reshoring	Södertälje (Eastern Sweden)	Multi-national Corporation	Own Product Expansion

Note. This table presents the case companies, their location, manufacturing strategy and ownership structure.

Above in table 3.2 the four case companies are presented. From the table one can derive information regarding what the company's name is, what type of manufacturing strategy they will use, where they are located geographically, their ownership structure as well as what type of investment their case is considered as.

As we can see from the table 3.2 above, 75 percent of our case companies consist of the same company. This is due to our criteria for case companies being so narrowed down, that essentially these four companies/four projects were the most relevant to our research question. In a perfect world there would have been four cases with four different companies, all located in different parts of Sweden operating within the exact same area. However, this was the available cases as of 2022, which we had to accept. However, although it is the same company behind most of them, the projects and the different cases are not equal in all its parts.

3.5 Validity and Trustworthiness

This paper chose to undergo research using the "thematic analysis" approach, which is a way of analysing qualitative data. Nowell et al. (2017) described that thematic analysis can be used to establish a high trustworthiness in a paper by demonstrating that the data analysis has been conducted in a precise, consistent, and exhaustive manner. Although it is often used with larger data sets, it may be used on analysis of smaller data samples as well.

The purpose of this research is to uncover and explore the factors of a phenomenon. The approach of the study is theoretical and aims to build the findings from the analysis of qualitative data rather than using a deductive approach and trying to test a hypothesis. This increases trustworthiness as there is no selective data collection, nor bias in the data collection that creates a false validation of the hypothesis. All the data used are available for everyone to see and use, which enhances the point that this paper is using consistent data which is unbiased. Some hard evidence like statistics, quotes, numbers, and other proven facts have been included to increase the validity of the data that was used.

As this paper is written on the sole purpose of the authors finding this topic to be interesting, there are no conflict of interests as could be the case if the paper was written on behalf of a company offering money as an exchange, for example. The authors of this paper do not work at either one of the case companies either, so there is no incentive for this paper to be biased towards the companies. These facts grant this paper a high level of trustworthiness as it looks at these companies from an unbiased point of view.

The approach of using thematic analysis as the basis for conducting the research is not a new phenomenon, as it has been used frequently by many others. Clarke and Braun (2016) discuss this in their article about thematic analysis, and they imply that it is useful for analysing small data sets with case studies with 1-2 cases, to larger interviews with 60 or more participants. Larger case studies have also been made using the thematic approach, so the usage of it is not new in literature. For example, a case study using the thematic approach by Esfehani and Walters (2018) was made about the cross-language in tourism and hospitality research. The authors succeeded in their process with thematic approach, which further proves the validity of this research method.

3.6 Ethics

The phenomenon analysed in this study is a recent and ongoing event. Relocations of battery manufacturing sites in Sweden is still in its very young days, and the purpose of this study is as explained before to understand the factors of opportunities and implications of the locational choice in Sweden.

As the companies compared in this case are publicly known, they will be presented with their full names without any anonymization. This paper will only cover data and research that is publicly available for everyone so there was no point in hiding the names of the companies,

which is a technique supported by Lietz et al. (2006). However, some quotes or statements that were found in articles, reports or in other information sources might be removed and replaced with their title instead. For example, if the CEO of Northvolt in Skellefteå made a statement, this paper will use the term “CEO” instead of the real name as the CEO might get replaced in the future, making his or her name a factor that may become irrelevant in the foreseeable future.

Dealing with these four case companies could become a sensitive issue as they are undergoing some of the biggest and most financed projects in Sweden as of right now (Investingothenburg, 2022). If this paper were to find strategies or other strategic parts that could enhance a competitor’s stance in the ongoing establishments could have devastating effects on all the projects. There could also be an incentive to the authors of this paper to make one company aware of its competitors current plans, in exchange for favours such as money, a job or similar services. This fact, combined with that getting an interview with these companies is difficult as they are super busy made it clear that this paper should instead focus on getting its data from publicly available sources. This will make sure that the validity and ethics of this paper is fulfilled, and since all information is available to anyone with an internet connection means that we have no incentive to lie or post false claims or statements of such nature.

4 Findings

This section will begin with an overview over some trends and themes in the lithium-ion manufacturing context, which will be followed by a brief description of some characteristics of the business environment in Sweden. After that, each battery case is introduced and systematically analysed in the three categories derived from the literature review.

4.1 Background

One of the strategic areas that Europe want to be able to act more independently in, is the production of Lithium-ion batteries. According to a report from the European Commission (2021) of their strategic dependencies, over 65% of the global production of lithium-ion batteries was produced in China 2018, and another 20% in other Asia Pacific countries. On the other side Europe's share of the production at the same date was estimated to account for a few percentages of the total global production. The last decade of technological advancement has allowed for tripled capacities of battery storage and significantly reduced the cost of production. These batteries are today used in a various applications including electronics, machinery, equipment, storage solutions in a renewable energy source, and for electrifying the automotive industry and phasing out the combustion engine. Many of the forecasts are pointing towards an exponential growth in demand the coming 10 years. The European Commission suggest lithium-ion batteries will be a part of the solutions to reach the decarbonization targets in the green deal and becoming net zero emitter by 2050, as negotiated under the Paris agreement.

The launch of European Battery Alliance in 2017 was first step towards becoming more autonomous in the battery value chain. The alliance is a substantial collaboration with over 400 businesses, institutions, local authorities, regions, and other actors where they are addressing challenges and supporting the creation of capabilities and infrastructure. They are setting up strategies and action plans for building up a new battery manufacturing factories in Europe on a broader scale. This is an initiative lead by both the European Commission itself and have financial support from the European Investment Bank.

4.1.1 Business environment in Sweden

According to the World Population Review (2021) Sweden is the fifth largest country in Europe by land size and eighth by annual GDP (Clarke, 2021). The International Trade Administration (2021) describes Sweden as a country that has developed a successful manufacturing production in the transportation, raw material, defence, robotics, and industrial equipment sectors. Furthermore, the country is also described as having achieved financial- and digital integration, but also come far in additive and agile manufacturing. The manufacturing industry is approximated to account for up to 20% of Sweden's annual GDP.

According to the European commission's website (2021), the EIB gave, in 2019, nearly 2 billion euros in financing for strategic investments in Sweden alone. This funding went to both battery manufactures and other forms of renewable infrastructure projects.

The Swedish Government have been active with policy instruments for incentivizing green investments. They have a goal of reaching carbon neutrality by 2045, which is five years earlier than negotiated under the Paris agreement. In the automotive sector specifically, they have adopted a "bonus-malus" policy instrument that aims to incentivizing customers to buy vehicles with low CO_2 emissions and placing higher tax on ownership of vehicles with higher CO_2 emissions (Transportstyrelsen, 2018)

Fossil-free sources of energy is greater in Sweden than any other nation in Europe and renewable energy accounts for about 53.9% of the energy produced which is the highest in Europe (Engström, 2020). Engström continues by stating that battery production demands very high quantities of energy, and thus a battery production in Sweden would entail the lowest environmental footprint in comparison to locating the manufacturing base in another European country.

Sweden possesses great potential with their mineral resources (Engström, 2020). The municipality of Bergby showed great potential when a mining corporation were prospecting the area for minerals and a similar potential was also found when prospecting an area further south in Sweden, where the essential minerals the batteries need was discovered in the ground according to Engström.

LKAB are currently working on making usage of their mine-waste from their iron-ore mine in the north of Sweden (LKAB, n.d.). New innovative technology from a Swedish waste

management firm can possibly enable LKAB to transform the minerals from their waste to useful materials for the battery-producers that are locating in Sweden. Boliden is another company who possess large opportunities for recycling lithium-ion batteries, and they are collaborating closely with leading universities and other research institutions in China and Sweden on the matter (Zackrisson, 2019).

The raw materials used in a lithium-ion batteries have several controversial and costly metals such as cobalt, lithium, nickel (Igogo et al., 2019). A major implication with manufacturing batteries in Sweden is the current dependency on external countries for the metals and active components required. Moreover, prices for components and minerals needed for battery production have been volatile as a reason for the long transports and the recent years disruptions of value chains (Hume, 2022). A recent report (Gregoir et al., 2022) highlighted growing shortages and bottlenecks for materials after the Russian invasion of Ukraine.

However, both Sweden and Finland have opportunities for producing a vast majority of the EU listed "critical raw materials" including rare earth metals, cobalt, lithium, nickel, mangan, and graphite. On the other hand, these metal assets located in northern Scandinavia and central Sweden and are unfortunately not active mines, but in exploration and different permit processes (LKAB, n.d.).

4.2 Northvolt Skellefteå

Northvolt is a start-up from 2016 that aims to produce lithium-ion batteries mainly for the automotive industry, but they also have ambitions of providing solutions in other various types of transportation and energy storage applications as well. The company has chosen its geographical location of a manufacturing and recycling facility in northern Sweden. Their R&D department was however decided to be placed in central Sweden.

The determination of the location was based on broad assessment of dozens of different locations across Scandinavia. Various municipalities in both Finland and Sweden were evaluated. The company mapped up a set of vital factors for be able to build up its manufacturing base.

4.2.1 Managerial due diligence

The foundation behind the business opportunity was according to their CEO that they saw a large future shortage of lithium-ion batteries. The existing global producers simply did not

expand sufficiently to be able to keep pace with the estimated level of demand in the electrification of the transport industry. Nor to the extent of being able to meet the storage of electricity at the rate at which Europe has added more and more intermittent energy sources in the energy mix.

From previous work in logistics in two multinational companies, the CEO described his insights into the difficulties of managing and coordinating activities in long value chains. This was particularly emphasized in views of the already high complexity of the automotive industry, which often has specific regional preferences, standards, and requirements to follow. Then, by having the production in close collaboration with R&D means that the company can be more responsive.

Another concern he had, was the sustainability aspect with the current battery production in other nations. Today's long battery value chains causing large ecological footprint and carries large risks for bottlenecks and vulnerability. Northvolt was therefore already from the beginning determined to focus on a regionalized and nearshored battery value chain, for building resilience and be able to produce the batteries with a low environmental footprint.

The company's chief environmental officer explained in an interview that an important part of the due diligence assessment, was choosing a local municipality with low complexity, and with little conflicting interest to achieve all required approvals. The local municipality in Skellefteå and other stakeholders showed a high willingness to wanting to speed up the required environmental and building permit processes. Before choosing northern Sweden as location in their assessment, they had several of other promising municipalities.

As the CEO said in an interview: "We looked at a location in Malmö harbour that had prepared for industrial projects. However, a population of frogs had already established themselves and thus created question marks about the environmental permits. We were also in Gothenburg and looked at an area close to Säve Airport, but experienced challenges associated with an environmental protected Natura 2000 area and uncertainty about the energy supply" (Sveriges Television, 2021, 23:20).

According to the CEO, the environmental permit usually takes 12-24 months. But in the case of the Skellefteå factory, they managed to convince the involved actors and agencies about the urgency of the production. Thus, managed to get the environmental permit after only 7 months.

The financing of companies' ambitions has taken place step by step and has so far amounted to tens of billions of dollars. The CEO described this process as a great uncertainty in the beginning and that carried high risks of delaying the process. However, the company have managed to get pre-booking of much of the production potential before even scaling up operations. They have also tied many stakeholders into partnerships, R&D activities or integrated them into the company as either lenders or owners. This has according to the CEO helped them reduce some of the risk for ending up in financial distress.

4.2.2 Changes in the external environment

The location choice of the battery factory was based on variety of factors specific for battery manufacturing, but also on a factors and condition in the external environment.

As the CEO further described "We needed a lot of land, we needed the right infrastructure and logistics, we needed expertise, and not at least, we need large amounts of electricity produced from renewable energy sources" (Sveriges Television, 2021, 20:55).

The power consumption of the planned processes in for Northvolt Skellefteå were estimated to corresponding to 1.5-2.5% of the Swedish electricity, requiring hundreds of hectares of land and access to large amount of water for cooling processes. Northern Sweden was a lucrative location as the production site could connect it production plant and recycling facility to grids that came from reliable hydroelectricity with low risks of power losses. Furthermore, they had also access to water and large areas of land at relatively affordable prices in Skellefteå. These were some of the favourable host country conditions that enabled a significantly reduced environmental footprint, compared to producing in a country whose electricity grids were powered by fossil fuels.

The availability of qualified workforce and establishing the manufacturing plant at an attractive location that skilled labour would like to stay were another important consideration when accessing the locations appropriateness. Nevertheless, in terms of total costs, labour was not as vital as cheap and reliable electricity. In fact, according to the project leader, the wage level discrepancy between highly qualified workers in Sweden and China have converged in recent years. However, the CEO has described the availability of staff with niche expertise in battery cell technology as a very scarce resource in almost the whole of Europe, and of course even more noticeable in sparsely populated northern Sweden.

The way in which Northvolt tried to avoid this barrier was by directly turning the recruitment processes towards the global labour market and focusing on Asian and American battery personnel. These people were described as leaders in that niche expertise. By doing so, they recruited people worldwide to move with the job, rather than waiting for the perfect conditions to emerge in the labour market or be limited to the local constraints around the location in north.

The location of the research and development department was not considered possible to be located at the same place as the manufacturing and recycling processes. Northvolt decided instead to place this department in Västerås and closer to the capital city. The reasoning around this decision was to be able to test, develop and experiment with the structure of processes and battery technology in advance, before implementing the full-scale production directly. In this case, access to the most qualified workforce and proximity to researchers, universities, organisations, and other stakeholders was considered more important than for the production itself.

It was also important to choose a location that were close to a port, airport, and other types of supply chain infrastructure. The port has an essential role to be able to complete the installation, build up a potential for receiving raw materials, but also to send heavy goods in the cheapest way. Sweden's otherwise very long transport distance with heavy vehicles and trains would include a much higher cost and larger amounts of CO_2 emissions than with current plans to transport the same weights and volume via sea traffic.

In the initial phase, the Swedish Energy Agency made a significant financial contribution to the Northvolt's sustainability work and innovation goals, which was in line with the government's own interests and goals. This state support proved to play a crucial role in later securing debt financing from EU's state-owned EIB, whose loans they needed to be able to afford to establish R&D laboratories and employ their expertise in the recruitment processes. With most of the funding secured for the development facility, a great deal of Nordic and European interest was aroused from various private and state electrification advocates. They were interested in joint development projects and could contributing with the rest of the funds required for completing the R&D lab in Västerås. This in turn, opened windows for new rounds of capital funding, and securing financing for the manufacturing processes in Skellefteå. New contributions from the Swedish Energy Agency, and further loans from the European Investment Bank, international banks, pension funds and foundations were

promised. In total, billions of euros have also raised through equity financing, where major European vehicle giants, pension funds and banks bought large shares of Northvolt (Pisani, J. (2021).

4.2.3 Strategic Shift

In terms of Strategic shifts. Northvolt have aimed to pursue a strategy of vertical integration of its supply chain, recycling, customized solutions, controlled manufacturing, and focus on reducing the battery's environmental footprint. Vertical integration refers to the strategy of taking ownership, managing all different suppliers and contractors independently without external outsourcing (Hayes, 2022). This makes the value chain shorter, and it provides opportunities to being transparent of its ecological footprint over its full lifecycle. The CEO and Northvolts environmental officer saw this strategy as particularly suitable to comply with new EU battery regulations that requires automotive companies are legally obligated to know where the raw material has been extracted from (HALLEUX, 2021). Developing full vertical integration is a great challenge that takes times to establish and there are few that have managed to achieve it as the CEO discusses. He also emphasized the opportunities with maintaining the intellectual properties, reducing bottleneck and supply chain risks. Furthermore, he pointed out that it is easier to educate, drive improvement and taking social and environmental responsibility of the full value chain.

Northern Scandinavia possess opportunities for regional extraction of battery raw materials which was additionally strategic factor behind the location decision. The CEO has stated that they aim to purchase all the material from the EU area and becoming more equipped to acting more regionally independent within some years, but also to recycle half of the materials in the batteries the coming decade. To achieve this, Northvolt applies a special separation technology developed at a Swedish university, to make it possible to resupply many of the materials required to the production process again. This is clearly in line with a strategic shift from the linear economy to a new circular type of thinking.

Several Swedish and European vehicles, energy, automation, recycling, and mining companies have entered strategic partnerships or alliances with the Northvolt. These partnerships aim to create clustering synergies and jointly share R&D efforts, exchange knowledge and build compatible battery solutions that meet standards, and business needs in different segments. Even state-owned companies, faculties in Sweden, the EU and China have

shown great willingness to collaborate and have been active in participating with expertise in recycling processes, electricity grid storage and battery technology for example.

Another strategic shift related to recent advancement in technology was the adaptation of industry 4.0 technology. Producing lithium-ion batteries is a type of process that requires a high degree of automation, digital connectivity, and systems in place for systematically gathering process data. These tools are needed to be able to achieve the desired quality, optimize factory processes, and be able to collect and map process information that can create better understanding of outcomes and precision over time. Northern Sweden has been characterized by mining, companies in process manufacturing and recycling. By establishing their production close these related industry actors they can ensure they have a solid ground for sustained innovation, interrelationships, strategic partnerships, and taking advantage of the already established cluster of mining, automation, and recycling competences.

4.3 Northvolt Borlänge

Northvolt Borlänge is a production plant located in the central Sweden. It is different to the other cases mentioned as it is not located close to a harbour or the next entity in the supply chain. For this case, the available resources such as skilled workers, access to clean energy and clean water was the focus for the company when deciding on where to establish its production. This company will produce components that will be used in other manufacturing processes in Sweden, to produce lithium batteries for both vehicles and energy storage.

4.3.1 Managerial Due Diligence

For the Borlänge case the establishment of the factory in this region will aim to keep out irresponsible building actors of the process when building this factory. This origins from the fact that the company had to deal with plenty of actors in the construction industry in Sweden which all had acted irresponsible and never fulfilled their promises.

There are videos of builders playing around and misusing their equipment that security cameras caught. This led to an investigation by the company which revealed that most of the construction companies wrongfully charged the case company for money and services that were never finished or took way to long time compared to its peers. To keep up with these demands and quality controls, the company decided to limit the subcontractor chain and demand more insight into each project if the subcontractors wanted to gain more access. Head

of External Communication at Northvolt Borlänge stated in an interview that “The basis of limiting the subcontractor chains is that we want to gain more control over who enters the buildings, and who the builders are. We don’t want people to cheat and abuse our equipment. The building of our previous factory in Skellefteå was like the wild west; full of people who do not belong in the building and construction industry” (Sveriges Television, 2022, 0;38).

With the focus of hiring great construction companies, and still having access to skilled workers let to the company deciding upon establishing the factory in central Sweden. This strategic choice also led to them being able to transport their batteries upon being completed to all parts of Sweden via trains or road transportation. The Borlänge case acquired a disused pulp manufacturing property that lay down its operations in 2021. That they now will transform and reconstruct to fit their needs. The property followed with large areas of lands, industrial waters and with much of the environmental permissions already on place. This is considered as “Brownfield-investment”. The factory is aimed to be done in just a couple of years, meaning that access to skilled workers and skilled construction companies were a big part as of why this location was chosen, but the location of the factory was also strategically close to its R&D lab which was another important aspect.

4.3.2 External Environment

The placement of the factory is in the central Sweden, meaning that the access to materials or transportation via water are not possible. They have access to smaller lakes and other water supplies which will be sufficient for them when creating and building batteries, however they will not be able to ship their batteries from the factory meaning that they will need to use other means of transportation.

One of the tools that they can use and which they will have access to is trains. The factory is located close by a train track as well as close access to one of Sweden’s largest roads, which will also be useful when they aim to ship out the batteries from the factory.

Due to the short time frame the pulp mill have been shut down and that they also were expected to use some of the existing process equipment and machines for manufacturing battery. Former workforce were seen as a very valuable resource for operating in established facilities. However, the planned battery processes are expected to be built out and too employee more than double of the amount of people that were employed before, so the CEO have stressed need for requiting people from abroad and other locations as well.

Since the factory is not yet established and expected to be done in 2024, the information regarding their access to energy supply is absent. However, one can assume that their goal is in line with what the rest of the three cases are in regards of power supply, which is to have access to renewable fossil-free electricity that will give them a stable supply for their energy intense demand.

4.3.3 Strategic Shift

The case will consist of an in-house manufacturing strategy where they produce battery parts which will be sold to other companies, but also moved to their own factories which are in different parts of Sweden. According to the CEO one of the most important factors was the geographical location which gives access to transportation via trains and trucks. As it is in the central parts of Sweden transportation times will also be lowered as they have factories in both the northern and southern of Sweden and having to drive across all of Sweden for transportation would slow down production a bit.

There are also workers with experience inside battery manufacturing which are located near the factory, which will help them in getting the factory started. As previously mentioned, the Steel Battery case bought an old factory which was just closed last year, which resulted in the departure of hundreds of people who are now jobless. This was something positive that could create foundations for synergies according to the CEO, as they will be able to hire back most of these people to work in various positions at the company.

The factory's proximity to R&D lab makes it also easy to have a close collaboration and be local responsive to changes in customer needs and preferences and achieve appropriate quality of the lithium-ion battery production.

4.4 Northvolt Torslanda

The Torslanda case is placed in a strategic geographically location which enables the company to have direct connection and work together with parts of the production chain that later will use the batteries in their manufacturing. It is located near the vehicle-manufacturing cluster in the western Sweden, which also means that it is located close to one of Sweden's major international harbours.

The ownership of the plant is a joint venture between Volvo Cars and Northvolt. Together they will establish and build a Gigafactory which will supply both Swedish car manufacturing as well as other international companies.

4.4.1 Managerial Due Diligence

The opening of the Gigafactory is yet to come as it is planned to be completed in the mid 2020's. This means that management had to make quick and rational decisions, which they found to be hard seeing as COVID-19 heavily impacted the delivery dates of parts that will be used for building the factory. Management also stated that they have had talks with close by cities and regions where the factory could be set up, but in the end, they made their choice based on its geographical location, as well as its supply of renewable energy and access to enormous amounts of clean water.

There have been some major bumps on the road of trying to establish the factory, however. Recently they discovered that rare species had inhabited the grounds where the factory was planned to be located, but these issues seem to have been resolved. Another large question was if they would be able to access the amount of renewable energy that they would need for their production, and yet again these issues seem to have been solved.

Seeing as the project is expected to be up and running in a couple of years, the factory is now growing larger each week. The establishment of this Gigafactory was a decisive move where the aim was to both transform one of the most dynamic automotive regions in the world, but also to become the leading global supplier of sustainable batteries.

The CEO also mentioned that the location will enable to companies to operate in a way which will greatly reduce the time it would otherwise take for vehicle manufacturers to import batteries from other countries.

4.4.2 External Environment

The production of lithium-ion batteries dominantly used in EV battery is described accounting for a significant proportion of the total CO_2 footprint across the whole lifecycle. Hence, a large opportunity for Northvolt Torslanda with this specific location is the access to a high density of fossil free energy mix in Sweden, which can make reduce the total CO_2 footprint tremendously, compared to if the manufacturing these EV batteries in other countries with

higher fossil dependence such as China, India, USA or even Germany (Emilsson & Dahllöf 2019).

Another large opportunity that promoted the choice of establishing the Gigafactory was the access to fossil fuel-free electricity as they have big demands to use sustainable and renewable energy sources. The access to electricity can also be viewed as an implication however, since the amount of electricity that is required to produce a battery is very high. The company had to make sure that the area where the warehouse was to be established, would have enough energy supply but also that the energy is fossil fuel-free which seems like a large implication.

Furthermore, the access to skilled workforce in in the nearby region was a factor that played a big role. But it was not just the clusters of skilled people that was important. The geographical location was in close connection to the R&D and design site. As previously mentioned, Northvolt Torslanda is located close to one of the largest international ports in Sweden, which also lies close to a car manufacturer where they will ship some of their batteries to when they are completed.

4.4.3 Strategic Shift

The strategic choice of the location was the most important factor for this case. It enables the case to access renewable energy sources with enough supply to create all their batteries, whilst at the same time having a geographical point that is close to the next step in their production chain. The location also offers the company to access highly skilled workers with enough competencies and experience which will help them in making this new Gigafactory work.

There has been a large emphasis on the sustainability aspect of this project. Not only on the factory itself, but also on future operations of the plant. Having access to renewable fossil-free fuel will enable this company to create and manufacture batteries of the highest possible standard, which in turn will help the automotive and other industries to reach their climate and sustainability goals. With its geographical location the company will also be able to easily access materials from all over the world, via airplanes, trucks, boats, or trains. This will make sure that they are supplied with enough materials to keep the factory going.

In a press-release made by Northvolt (2022), the CEO said that “We have looked at a multitude of sites, both inside and outside Sweden. We ultimately chose Gothenburg because of the infrastructure, the logistics, the proximity to the Volvo Cars factory where we get the materials, access to fossil-free energy, and access to skills.” This is in line with what the rest of the articles regarding Northvolt Gothenburg had to say, which further strengthens the CEO’s claims.

All the above discussed points are important for the case, and they all come down to where they choose to establish this Gigafactory.

4.5 Scania

This case regards a production site that is to a 100% owned by the multi-national corporation Volkswagen Group. This manufacturing site produces full EV batteries but has the battery-cell production outsourced to another Swedish producer, which is Northvolt Skellefteå. Important to know about this case is that Volkswagen Group and Scania own a significant share of Northvolt Skellefteå. The location of the battery production plant is near an EV cluster, as it is located at the site of the Scania headquarters, which differentiates the characteristics of this case to some of the others. Furthermore, the investment in the new battery manufacturing and assembly sites are a near-shoring strategy since these components where previously imported from an outsourced offshore supplier.

4.5.1 Managerial due diligence

As mentioned by both the director of the battery production site, and by the manager of production and logistics of Scania, the most important aspect of the site is that it is dependable in form of quality and in supply. The last years events have both disrupted international supply-chains and thus led to a reshoring strategy for the managers to ensure dependability and access to batteries. Furthermore, the manager of production and logistics state that a full-scale production of batteries on-site is a prerequisite for opening large scale production of EV’s.

As stated by the director of battery production the chosen manufacturing strategy ensures that the batteries are under internal control. “The fact that we have had our own production [of batteries] for some months has been crucial for acquiring competence and preparing us for handling larger volumes which has facilitated the improving of vehicular parameters of

performance and range" the director stated in an interview with Rejlers Play in 2020 (YouTube, 2020, 4:24). This implies that EV's and plug-in hybrids would be customizable for Scania in terms of tuning EV's, so they get the desired features, performance, and range. The director states that it will be a competitive advantage to develop the batteries and chassis concurrently.

Another significant factor for opening a battery production and assembly site was access to capabilities and skilled staff. The site would require several hundreds of new workers, and capabilities in form of receiving and dispatching of components as well as machinery and technology that can manage and automatize the production. In addition to the capabilities in form of skilled staff and competence, which Scania had acquired from working with imported batteries from a Japanese manufacturer earlier, Scania was looking for machinery that could handle batteries.

As stated by the director capabilities in form of machinery is already present and furthermore, automatized processes all the way from reception of goods to shipping currently exists at Scania. Thereby the chosen location would require the least initial investments, while it also increase the synergies for the company while being located so close to research and development as well as the next step in the value-chain where the batteries get put into the chassis.

The initial opening of the battery production site of Scania took place under the third quarter of 2020, a time where much staff in production had to work from home and a time where traveling across nations were heavily restrained. The director of battery production stated that having the production site close to the headquarters, management and the later parts of the supply chain protected the operations from the short-term effects that COVID-19 had. Having the production near all primary stakeholders and employees meant that the facilities could continue to operate as usual even under restrictions.

4.5.2 External environment

Managers of Scania stated that the interest in electrification of transport and vehicle industry is the greatest in the Nordics and Netherlands. In an interview, they argue that operating the battery production in an environment that has an interest of the products creates a cohesive operational process between manufacturing and the market.

A part of the external environment is that the new production site and research and development lab will be located next door to the headquarters and chassis manufacturing site of Scania. From the perspective of logistics, the battery production site will be reshored Sweden, where Northvolt produces the battery cells they supply Scania with. The director of battery production at Scania mentioned in an interview that operating in the same country as their supplier was beneficial during the pandemic as they did not suffer any significant shortages of components in their production due to restrictions or disrupted supplies.

Scania invested in the opening of the battery cell production at Northvolts' plant in Skellefteå, which is supplying them the battery cells today. The director of Scania's battery production said in an interview that switching to the supplier that they are now a shareholder of will ensure that their future demand of battery cells will be secured. Additionally, the Northvolt Skellefteå invests in labs and sites that has the goal of refurbishing and recycling old batteries, as well as their aim that all the energy used in the manufacturing will come from renewable sources.

The director of Scania's battery production stated that "I am impressed with the drive and conviction at Northvolt, matching ours at Scania and Northvolt wants to invest in their production facilities ensuring a clean energy supply for production. There is an emphasis on recycling batteries" (Youtube, 2020, 6:26). The sustainability performance of suppliers is a critical factor for Scania's sourcing decisions and having a producer that emphasise sustainable production in Sweden was important for Scania.

Regarding the external environment, Scania stated that Sweden possesses clusters of capabilities for building EV batteries. They also mention that there is healthy competition in Sweden for battery production and electrifying the EV industry. The view of Scania is that working in an environment like this ensures access to important capabilities as well as the competition is believed to lead to innovations.

4.5.3 Strategic shift

The strategic choice concerning the battery production winded up being an in and out reshoring manufacturing strategy. To understand what factors were important in the consideration of this decision, Scania has stated on their webpage that sustainability performance of suppliers plays an important role for sourcing decisions. Additionally, they state that performance regarding technology, quality, costs, and delivery plays an equally

important role alongside with the sustainability performance. The standpoint of Scania is that the production site, for either an internal or external supplier, must meet the same standards of practice that this firms demands from their internal business activities.

To assess and measure the performance of potential suppliers regarding the factors of consideration, Scania collect information from a questionnaire where suppliers demonstrate their performance in sustainable sections like health and safety, human rights and working conditions, environment, ethics, and management. In combination to the internal assessment, Scania says that risk indices from the global risk consulting firm Maplecroft to facilitate the strategic choice of production by giving a more complete view of the risks connected to each potential sourcing strategy.

Sustainability and responsibility are two important factors that define Scania. As an example, they are a part of a large internal collaboration at Volkswagen Group that focuses on their due diligence regarding human rights management. The internal program aims to follow the OECD general due diligence guidelines and the UN principles to identify and mitigate the human rights risks in their supply chain.

Shifting producer from the Japanese producer that produced battery modules, to a supplier of battery cells that operate within Sweden should be seen as a shift from outsourced offshore strategy to an in and out reshoring strategy. This is a strategic shift from offshore as they move supplier from Japan to Sweden, and from outsourced to in and out as the manufacturing today will take place in both Northvolt Skellefteå and in Scania's own production site.

5 Discussion

In the discussion, the reader will be presented an analysis of the findings of the study and the existing literature. The cases of the study will be discussed to address the similarities and differences and how they align with previous research.

To get an overview of how battery manufactures undergo the decision-making process of deciding location, two tables that list the factors, opportunities and implications were created. In the tables below each company is compared and analysed with the new findings as well as what was supported by the factors that have been explained before in the literature review**.** The tables include references from the literature review to increase validity and trustworthiness. The factors have been thematically divided into three categories. This helped to pinpoint the differences and similarities in factors from each different category which impacted the companies to locate their battery production in Sweden. Factors and opportunities were put in the same table as they shared most of its factors with each other. Below are the two different comparison tables, "Factors and Opportunities" (table 5.1) as well as the "Implications" (table 5.2).

By creating these tables, the paper aims to further educate and shed light upon the new factors, implications and opportunities that were missing in the literature. The intention was also to view the available research that has been conducted. The tables are useful for quickly viewing the factors and implications and what was found to be new and interesting topics in this research field.

Table 5.1

Factors and Opportunities

Category	Factors & Opportunities	Skellefteå	Borlänge	Torslanda	Södertälje	Literature Review	Supporting Literature
Due Diligence:	Access to Finance	X			X	X	Srai & Arne (2016)
(New)	Low permit-process complexity	X					
	Muncipality engagement	X	X	X		X	Srai and Ané (2016)
	Politican engagement	X	X	X		X	Ruggie (1994)
	Attractivenss of destination	X	X	X	X	X	Antelo & Bru (2010)
	Close to R&D			X	X	X	Ashby (2016)
External Environment :	Renewable electricity	X	X	X	X	X	Engström (2020)
	Access to Port	X		X	X	X	Engström et al (2018)
	Local Labour Market			X	X	X	Ellram et al (2013)
	Wage levels	X	X			X	Smith (1778), Richardo (1817)
	Political subsidies	X				X	Ruggie (1994), Krugman et al (2018),
	Cluster of industries	X		X	X	X	Dunning (1980), Porter (1994)
	EU financing	X				X	Raza et al (2021)
	Raw material	X	X	X	X	X	Srai & Arne (2016), McIvor & Bals (2021)
Strategic Shift:	Sustainability	X	X	X	X	X	Ellram (2013),
	Quality	X	X	X	X	X	Engström et al (2018)
	Strategic partnerships	X	X	X	X	X	De Backer et al (2016)
	Industry 4.0	X	X	X	X	X	Dachs et al (2019), Kaivio-Oja et al (2018), Winkler (2020), Bárcia De Mattos et al (2021), Raza et al (2021)
(New)	Regional Autonomy	X	X	X	X		
	Country of origin					X	Piatanesi & Arauzo-Carod (2019), Fratocchi & Stefano (2020)
	Interdependencies	X		X	X	X	Di Mauro et al (2018)
	Local responsiveness	X	X	X	X	X	Barlett & Ghosal (2002)
	Synergies	X	X	X	X	X	McIvor & Bals 2021

Note. A compilation over the factors and opportunities that was found. Created by Helenefors, Jakobsson, Uldin, 2022.

Table 5.2

Implications

Category	Implications	Skellefteå	Borlänge	Torslanda	Södertälje	Literature Review	Supporting Literature
Due Diligence:	Enviromental regulations	X	X	X		X	Engström et al (2018), Viking (2017).
	Time delays in execution	X	X	X		X	Raza et al., (2021)
	Permit processes			X		X	Söderholm et al. (2015), Viking. 2017)
	Quality issues					X	Kinkel (2014), Engström et al., (2018).
	Hidden costs	X		X		X	Ashby, (2016), Fratocchi et al. (2016)
	Miscalculations					X	Weismann et al. (2017), Bals et al. (2021)
External Envrioment :	Shortages and lead times	X	X	X	X	X	McIvor & Bals (2021), Raza et al (2021).
	Trade barriers			X	X	X	Ruggie (1994), Krugman et al., (2018),
	Access to qualified labour	X	X			X	Engström et al., (2018).
	High inital investments	X	X	X		X	Barbieri et al. (2018)
	Competition	X	X	X	X	X	Porter (1994)
	Inflation	X	X	X	X	X	Srai & Ané 2016
	Energy cost		X	X		X	Smith (1778), Richardo (1817).
	Labour costs		X	X	X	X	Smith (1778), Richardo (1817).
	Infrastructure		X			X	Ellram et al., (2013), Weismann et al. (2017)
Strategic Shift:	Access to raw material	X		X	X	X	Eurometaux (2022), Engström et al., (2018).
	Geopolitical uncertainty			X	X	X	Borell, J. (2022), (Hume, 2022), Gregoir & Van Acker (2022).
	Controversial mining					X	Nkulu et al., (2018), Slack et al., (2017).

Note. A compilation over the implications that was found. Created by Helenefors, Jakobsson, Uldin, 2022.

5.1 Due diligence

One of the factors of choosing a certain location of a battery factory has been the municipalities, politicians, related industries, and organisations willingness to collaborate. An insight that was found in the study, was how local opposition and bureaucratic process are differentiating between municipalities and may both enable and disable a locations potential.

Choosing a specific country due to political trade policy environment are supported in theory by (Krugman et al., 2018; Ruggie,1994), and Srai and Ané (2016) elaborated one step further and pointed on local incentives which can be an important driver in combination with other factors behind the location choice. The environmental regulations have been described as barrier for reshoring to Sweden by Engström et al. (2018), and this have been a factor other researcher have discussed in determining location as well (Ellram 2013; Weismann; 2017). The theory around institutional complexity itself, and that there exist a variety of different coordination mechanisms and regulations that makes permit processes problematic is not anything unknown and is described by (Söderholm et al., 2015; Viking, 2017).

However, what has not been explained and that adds a new perspective in manufacturing strategy context is the approach of actively evaluating municipalities depending on regulatory complexity and degree of conflicting interest among different stakeholders. It appeared to be a new factor within the due diligence category discovered in this study, that previous manufacturing strategy literature has not considered in the process of making a location decision. The factor is an important location factor, because it showed to be an enabler for the investment itself and be a time saving factor to take into account.

The permit processes differentiated between the four cases. It was only Skellefteå and Torslanda that needed to apply for permissions from scratch. The Torslanda case experienced most time delaying affects in their permit processes due to animal protection regulations, recalling from the CEO of Northvolts earlier citation. This could likewise have been the case for the Skellefteå factory as well if they if they proceeded with other locations, but they managed to overcome it by seeking for a location with lower permit-process complexity. In contrast, the factories in Södertälje and Borlänge could make use of established industrial land areas of production to only seek parts of the permissions to expand for. All facilities have also implied many new work opportunities and implied limited environmental impact on the specific location, which potentially are reducing some of the local opposition (Söderholm et

al., 2015; Viking, 2017) and environmental regulations that Engstöm et al. (2018) have problematized.

Another aspect that all companies shared, was choosing a place with a high destination attractiveness to be able to attract and retain its internal competence. The limitations in local labour market that an unattractive location has is a well-known phenomenon and described by (Ellram, 2013; Engström et al., 2018).

One interesting way of tackling the local labour constraints found in the study, was how Northvolt in Skellefteå and Borlänge turned recruiting processes towards international competences directly. They were also working closely with local decisions makers and faculties to facilitate suitable new infrastructure and education programs. This leads to the thoughts of how quickly municipalities can manage to develop schools, healthcare and keep up with accommodation, but also if it is possible to overcome the local labour constraints by sufficiently large and attractive reshoring investments.

From the literature review, the theory of why offshoring or reshoring often fails, was commonly described as a results of mangers doing mistakes in forecasting of different costs, financial measurements, or recognizing the true market share (Wiesmann et al., 2017, McIvor & Bals 2021). In addition, the failure of a location choice could also be related to intangible factors, such as achieving the appropriate quality of the manufacturing processes and executing all the required steps to in time and meet their obligations to customers and lenders (Kinkel, 2014; Ashby, 2016; Fratoccchi et al. 2016). This is of course something that not yet can be ruled out. However, the public access to this kind of information have been of very scarce nature and could not in depth be analysed in this study.

Building up lithium-ion battery manufacturing processes has a tremendous high complexity involved in it, and much speaks for that a plethora of different technologies must be synchronized and appropriated installed before the production processes can begin. An implication regarding this, that was found, was therefore the role of execution and how it can cause lengthy time-delays for the case companies (Raza et al., 2021).

5.2 External Environment

The factors that the case companies have considered important behind the location choice of a lithium-ion battery factory, shows similarities but also small deviations in the reasoning among the cases in the external environment.

One insight from the findings is that the general cost differences in terms of qualified labour seemed to have converged and made it reasonable to take a higher salary level when adding up against other types of factors specific for the battery industry. These patterns are similar insights to what McIvor and Bals (2021) and Raza et al. (2022) saw in studies of other reshoring companies. They experienced reduced discrepancies in terms of salary levels for the most qualified workers, making reshoring preferably over offshoring in some cases.

The access to cheap, reliable, and renewable sources of electricity seems to be an essential factor for being able to establish a battery factory, which in Northvolt Skellefteå- and Borlänge's case was considered even more important than access to a strong local labour market. This was slightly different from the reasoning in Gothenburg and Södertälje where the access to qualified labour and the most efficient value chains could not be compromised. Renewable energy is a factor all 4 different cases took into consideration. This factor of location decisions has been described as important in terms of relative costs by (Ricardo, 1817; Dunning 1980), but it is a relatively new insight that companies choose location due to the characteristics of the electricity itself.

Another factor of opportunity with locating battery manufacturing in Sweden have been clustering of business, strategic partnerships, and knowledge spill-over effects among other electrification advocates. This is much in line with (Dunning,1980; Porter 1994) literature around economies of scale and how already established strong network of related businesses creating conditions for positive externalities. Our study shows examples of a supportive engagement from both private-, public-, state-, EU- organisations. Northvolt as examined, manged to receive significant subsidizes and raise debt- and equity financing in a very large scale.

Another important factor was the access to raw material as well the supply chain and other different beneficial host country infrastructure. The access to port and air-port, and raw material was the part of infrastructure that was shared most frequent among the cases. The only exception was for Borlänge as they had no possibilities to ship goods or materials

through the oceans directly, but had instead close access to a large rail-way network. These finding are not anything new and clearly supported by previous literature in OCSM research (Ashby, 2016; Wiesmann et al., 2017; Barbieri et al., 2018), but at the same time it further highlighting the logistical infrastructure's important role for building up large scale manufacturing processes, since nearly no one seemed to compromise in this area.

The stiff international competition was a common implication shared in the external environment. All the cases examined in the study are competing with large multinationals such as CATL, Panasonic, LG Chem, ByD, Toshiba and Tesla. These companies are currently accounting for most of the market share of lithium-ion battery production and have strong financial muscles behind them and to withstand periods of crisis and shocks (Bohlsen, 2019). They are also investing heavy into R&D activities which can lead to new substituting technologies of what the case companies are scaling up of (Brigham, 2020).

Volvo Car and Scania have recently announced in their first quarter earnings (2022) that they are experiencing implications in the second quarter, as result of renewed lockdowns in China and due to the inflation on input goods of their manufacturing processes. The shortage of semiconductors, advanced ships and some critical raw material may potentially delay some of the installation processes for the battery factories and effect their capabilities of what is possible to produce.

On the other hand, the Swedish Riksbank and other central banks in the world have also taken a large twist in expansionary monetary policy towards more of tightening monetary approach. To get the inflationary pressures back to pre-pandemic levels, with several expected interest rates hikes the coming years (Johnson, 2022). The outcomes of these changes in this economic policy, are yet unknown what it could imply for the factories in terms of additional financing costs, and to the extent that it changes any of the case companies' investment objectives.

5.3 Strategic Shift

An important aspect of location is dependability in form of quality and supply. The current years events have both disrupted international supply-chains and thus led to a reshoring strategy for the managers to ensure dependability and access to batteries. This finding is in line with the findings in their paper of Netland and Frick (2017) that found that that quality and dependability were of the highest priority to compete successfully against other firms.

Furthermore, the requirement of customization for different battery applications, and desire to satisfy the customers time expectations was also something important that was mentioned in all cases, this is supporting Bartell and Ghoshal (2002) findings of that reshoring companies or sectors tend to have a larger requirement for being locally responsive.

The use industry 4.0 technology, as (Dachs et al., 2019; Kaivio-Oja et al., 2018; Winkler 2020; Bárcia De Mattos et al.,2021; Raza et al., 2021) argued been important factor to reallocate production, was indeed a factors that all cases shared. Northvolt R&D was strategically located in same town as ABB R&D in Västerås. ABB is a leading automation, robotics, and process technology company. They have entered a strategic partnerships together and experimented with industry 4.0 solutions to attain a high degree of automation in the manufacturing processes. However, the possibilities of taking advantage of productive technologies as a main factor for producing in Sweden have not been communicated as a central reason.

A strategic factor that instead has been highlighted is the sustainability factor. This factor has been addressed in a variety of different aspects and been described as a central theme for producing in Sweden. Perhaps this could indicate that sustainability has become an increasingly important aspect in manufacturing in comparison to in 2017 (Frick, 2017). The presence of sustainability as an important factor for the strategy in all cases further disapproves the findings of Frick and Netland (2017) who found that the importance of sustainability in the manufacturing strategy had decreased in importance in comparison to other factors.

Choosing a country such as Sweden with high share of renewable electricity (Engstöm,2020), was described as a key priority to keep the environmental footprint down and as approach for developing competitive advantage towards their international peers. When reflecting on the EU's new stricter requirements for battery companies to be able to produce recyclable, to be able to provide the origin of raw materials (HALLEUX, 2021), and the specific standards that have been characterized the automotive industry (Raza et al., 2021). It can be assumed that the importance of working close to R&D and with suppliers in the shorter value chain increases, and that it creates conditions for inventing customized solutions and maintaining intangible properties more easily (Ashby, 2016), than compared to having an offshore battery strategy.

The access to raw materials was earlier examined as an important external factor. In addition, all case companies have gone one step further and communicated goals and desire for acquiring raw material in a socially responsible manner and to try to become more independent from problematic counties. Sweden became a strategic location for its mining history, relevant technology and of future potential for nearshored supply of raw material. Nkulu et al. (2018) and Slack et al. (2017) are criticizing some of the latest technologies including Lithium-Ion batteries because some specific raw materials may have connections to child labour, corruption, health, or safety concerns. Hence, this sheds light on a part of the location decision that rarely are being stressed.

Bailyn (1985) discussed about creating autonomy in R&D, Lippert et al. (2019) and Fiott (2018) mainly spoke about developing independent defence capabilities but was not finding any connections to the industrial context for this phenomenon. Thompson (2019) and Youngs (2021) was criticizing the strategy of nations trying to aim for total autonomy. This study highlighted a contradictory situation. Where regional autonomy in materials was a factor that the cases took into account in the location assessment. In this study, aiming for more regional autonomy in materials has been an important factor from an environmental perspective and as a competitive strategy. Furthermore, it has been described by the companies as one way to reduce bottlenecks risk in supply chains and manage geopolitical tensions (Borell, 2022; Hume 2022). This is therefore adding a new factor in the IB and OSCM literature on location choices, which can be useful to research more about, as well as to include in further assessments of where it is appropriate to locate different types of manufacturing processes.

The implications found in strategic shift was rather thin. This can be assumed to have to do with competitive reasons and that companies do not want to disclose any sensitive information that serves self-interest of others. Out of the four case companies, only Volvo Cars and Scania are publicly listed and required to present quarterly financial data. These companies have announced to pause their internal operations in Russia as result of the aggression in Ukraine. These factories are however not any of their core business and not connected to its battery production processes directly. However, the implications and uncertainty with the geopolitical development and current trade barriers with Russia as well as new lockdowns in China, is still causing concern about internal access to materials, semiconductors, and cost increases (Hume, 2022; Borell, 2022; Gregoir & Van Acker (2022).

6 Conclusion

6.1 Summary

This study aims to increase the understanding of what factors businesses considers when deciding location of a battery manufacturing process in Sweden. The study is a comparative case study that evaluates four different establishment processes. It reviews a broad amount of manufacturing strategy literature in both the IB And OSCM. A particular unique character of the study is that it has targeted an industry that have been highlighted strategically important for EU‘s industrial strategy. The study is using Barbieri et al. (2018) three categories to thematically evaluate factors during both the decision making and implementation process, which it later derives two tables of opportunities and implications respectively of with supported literature references. In this way, the reader can realize the differences and gain a new updated understanding of location decisions for a manufacturing base

Overall, the main theoretical contribution is the discovery of two new factors of opportunities that previously not have been identified in the literature. The first one was seeking municipalities with low permit process complexity in the due diligence process, and the second one was choosing a location that has possibilities for attaining regional autonomy in material supply, as a strategic internal consideration.

The sustainability aspect was one of the most common factors behind locating battery factories in Sweden. This is slightly contradictory in how other researchers have viewed the role of sustainability in manufacturing location decision (Frick et al., 2017; Ricardo, 1817). The focus of sustainability comes with many sub-categories, where this can be tied to both access to clean water, renewable electricity as well as its access to further parts of its supply chain within a small travelling distance which in turn will reduce the amount of transportation that is required to keep their production line going. In addition, the focus on recycling raw materials of the batteries after their use, was another factor they considered, which has not been addressed in previous literature as an important part of the location decision.

Some other important factors with locating a lithium-ion battery production process in Sweden were the possibilities for creating appropriate quality, being locally responsive to standards and preferences. Furthermore, the locations attractiveness, strategic partnerships, and opportunities for getting internal or external synergies out of the location have also been vital sources behind the location decision. These finding are highly explained by what we

already know (Engström, et al. 2018; Bartlett & Goshal, 2002; De Backer et al. 2016 Antelo & Bru 2010; Porter 1994; Krugman et al. 2018; Srai & Arne 2016; Bals & McIvor 2021).

However, taking advantage of productive technology and integrate a high degree of industry 4.0 in the manufacturing processes, has been an important component of the decision. This is still contradictory of how Bárcia de Mattos et al. (2021) saw risks of ending up with many job losses, and that it was a major enabler for re-/nearshoring production (Dachs et al. 2019; Kaivio-Oja et al. 2018). What instead was experienced for the battery cases, was that it was very labour intense and thus instead created challenges with recruiting all labour. Furthermore, the technology itself has not been described as a key aspect of location in Sweden specifically. Close collaboration with R&D and the ability to be innovative and preserve intellectual properties has instead been more empathized (Ashby, 2016).

The main practical implications discovered was the high initial investments and stiff international competition that potentially can developing substituting technologies of lithium Ion-batteries. Sweden's environmental regulations (Engstöm 2018), lengthy permit processes (Viking 2017), can delay the time frame for the companies (Raza et al. 2021). Nevertheless, it seems to differ in complexity depending on the municipality and what the specific land area itself is characterized as. Therefore, by actively seeking municipalities with local incentives and high political- and municipality engagement (Ruggie 1994; Srai and Ané, 2016) and seeking a location with low permit process complexity and little tensions. Can this be the basis for a competitive localization strategy.

Moreover, another practical implication that was found was that neither Sweden nor Europe are self-sufficient in raw material supply to lithium-ion. This entails further risks of bottleneck 's and price volatility for the production during the ongoing war in Ukraine (Hume, 2022; Gregoir & Van Acker, 2022), which ultimate outcome are deeply uncertain.

6.2 Limitations

This study has concentrated on factors, opportunities, and implications for battery manufacturing in Sweden. It can also be useful for understanding some of the dynamic in a European context as well. But in general, the result cannot be assumed to be applicable in different countries, neither generalizable over other types of strategic sectors. It is not possible to make inferences of general trends or manufacturing strategies in general since this theory is affected of many specific circumstances and business requirements in different contexts.

A concrete limitation of this study is that it is primarily based on various sources of secondary data. Even though the study is including perspectives from different mangers, public interviews, press releases, financial reports, and podcasts, that should be accurate and truly faithfully representative information. It may still be affected by different kinds of biases into different extent favouring the case companies and stakeholders' self-interests. Some of the case companies in the study are also publicly listed companies and ongoing initiatives. Therefore, due to competitive reasons, full disclosures of the current implications and current complexity the companies are facing cannot be assumed to be presented holistically.

Seeing as the companies are publicly listed, and that they are establishing their factories as of right now, getting an interview with the case companies showed to be very difficult. Most of the people that were contacted did not even respond which can be understood since they have ongoing projects and are most likely busy with getting their projects up and running.

6.3 Proposed future research

Future research could examine other types of strategic industries such as raw materials, pharmaceuticals, semiconductors, hydrogen or cloud and edge computing, which all have been highlighted in the EU's industrial strategy. All these sectors are today experiencing a rapidly changing environment, in which all has unique features and characteristics specific for its context to take into consideration. For example, a finding from our case study is that the environmental permission processes seem to differ in complexity and time it takes to get permissions in different municipalities.

A possible topic for further study could therefore be to investigate how conflicting interest on local municipalities level clashes with national interest in the context of establishing new raw material mines in Sweden or Finland. The mining industry seems to be an industry with more local resistance from various stakeholder in permitting processes compared to the cases we examined in the battery manufacturing context. Research in that area on finding ways for conflicting stakeholders to coexist, reducing the time it takes get permitting processes, compensate interest groups or local municipalities for potential unfairness, would be important continued research for policy makers, entrepreneurs and from a European Strategic Autonomy perspective.

Another interesting idea that remains to be explored regarding this is therefore whether formulating business models with a mutual interest of a region, preferential trade zone and a

business environment provide additional benefits as a competitive strategy, in terms of financing, or spill over effects (Krugman 1983; Porter 1994). However, this would preferably be the area of investigation of a much more quantitative research type.

7 References

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