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Managing social problems with an agency perspective

A case study on strategies for socially sustainable sourcing of cobalt in the automotive industry

Master's thesis in the Master's Programme Management and Economics of Innovation

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ABSTRACT

The transition towards electromobility is essential to reduce CO2-emissions but brings new challenges to automotive manufacturers. Cobalt, a vital metal in most batteries for electric vehicles, is associated with serious violations of human rights when it is extracted from mines in the Democratic Republic of the Congo, the largest cobalt producer in the world. The long and complex supply chain of cobalt creates agency problems for automotive manufacturers who want to address the social issues associated with cobalt as responsibility must be delegated for them to do so. It is thereby difficult for automotive manufacturers to ensure that the cobalt in their products is ethically sourced.

To guide automotive manufacturers through these challenges, the aim of this thesis is to identify agency problems that affect the social sustainability in the supply chain of cobalt and explore which strategies are suitable to manage the social sustainability.

The thesis was conducted as a case study at a large automotive manufacturer. The adopted methodology involved identifying and evaluating strategies based on hypotheses that were developed and refined based on data from interviews, workshops and secondary sources. This was followed by an in-depth analysis of the strategies based on agency theory, transaction cost theory and multi-tier supply chain management.

The findings suggest that automotive manufacturers should choose between a strategy where they interact directly or indirectly with sub-suppliers depending on the automotive manufacturer's risk profile and contextual factors. Firms should opt for a direct strategy if they are risk-averse towards agency problems and social sustainability but can accept an asset specificity risk. Firms with an opposite risk profile should choose an indirect strategy. The findings also indicate that firms who adopt a direct strategy should implement a supply chain transparency strategy that gives them high visibility over their supply chain while firms that use indirect strategies can have lower levels of transparency. Regardless of whether a direct or indirect strategy is adopted, firms should engage in artisanal mining and initiatives with other downstream firms.

Future research is suggested to further examine how contextual factors can make it more favorable for companies to invest additional resources to improve the social sustainability of cobalt. The relationship between firm risk profile and suggested strategy should also be investigated further through more extensive empirical data.

Keywords: Social sustainability, agency theory, transaction cost theory, multi-tier supply chain management

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TERMINOLOGY & ABBREVIATIONS

Artisanal and small-scale mining (ASM)	A type of mining where only simple tools or hands are used to extract minerals, operated by individuals in developing countries
Battery cell	Consist of a negative cathode and postive anode which, when connected to each other, create a flow of electrons
DRC	Democratic Republic of the Congo
Electromobility	Transportation based on vehicles propelled by electricity
EV	Electric vehicle
First-tier supplier	A supplier who provides goods or services directly to the buying firm
Focal firm	A company governing the supply chain and having direct contact with end customers
Large-scale mining (LSM)	Mining production where sophisticated techniques and equipment are used to extract minerals, often operated by international companies
Multi-tier supply chain	A supply chain which takes sub-suppliers into account as opposed to only the relationship between the buying firm and first-tier supplier
OEM	Original equipment manufacturer
Social sustainability	A business' impact on people
Sourcing	Acquisition of goods or services
Sub-supplier	A supplier who provides goods or services indirectly to the buying firm through the first-tier supplier

1 INTRODUCTION

This chapter presents a background of the study followed by the study's purpose and research questions. Lastly, the delimitations of the study are presented.

1.1 BACKGROUND

The transport sector is facing a major challenge in reducing its CO2-emissions. The European Environmental Agency (2019) states that 27 % of greenhouse gas emissions within the EU came from the transport sector in 2017. Electromobility is an important measure to reduce greenhouse gas emissions as electric vehicles (EVs) are energy efficient and lack tailpipe emissions (Figenbaum et al., 2015). EVs are, therefore, essential for the EU to reach its goal of a 40 % reduction in greenhouse gas emissions in 2030 compared to 1990 levels (European Commission, 2014).

The market size for EVs is growing rapidly. In 2018, 2.1 million fully and semi-electric vehicles were delivered globally, a 64 % increase compared to 2017 (Irle, 2019). The adoption of EVs is projected to increase further as about 70 % of all vehicles sold in Europe in 2040 (including passenger cars, vans, trucks, and buses) are projected to be electric, with global yearly sales reaching over 100 million units (Eddy et al., 2019).

As the market for EVs is growing rapidly, so is the demand for batteries used in these vehicles. The manufacturing capacity of lithium-ion batteries, which is the dominant battery technology for EVs (Fotouhi et al., 2016), is projected to increase with four to six times by 2022, compared to 2017 levels (Lebedeva et al., 2018). There are different variations of these batteries with different material compositions. Lithium nickel manganese cobalt (NMC) and lithium nickel cobalt aluminum (NCA) are the most common types today and are projected to dominate the market until at least 2030 (Azevedo et al., 2018). Both NMC and NCA batteries, thereby, contain cobalt, a metal that is often mined under problematic conditions.

The Democratic Republic of the Congo (DRC) is by far the largest producer of cobalt in the world. In 2018, the U.S. Geological Survey (2019) estimated that more than 60 % of all cobalt was mined in the DRC while Russia and Cuba, the second and third largest cobalt miners, accounted for roughly 4 % each. According to the European Commission, the DRC will continue to be the main cobalt exporter as demand for the metal increases (Alves Dias et al., 2018).

The main problem with cobalt mining in the DRC is related to artisanal mining, a small-scale form of mining where the miners only use their hands or simple tools to dig. According to Amnesty International (2016), 20 % of the cobalt in the DRC is mined by 110,000 to 150,000 artisanal miners. Yet, artisanal mining is subjected to human rights abuses, such as child labor. Amnesty International (2016) estimates that there are roughly 40,000 children working in artisanal mines in the DRC. Poverty is the main reason as to why child labor is prevalent in artisanal cobalt mining in the DRC (Faber et al., 2017). According to the World Bank (2019), the DRC is the third poorest country in the world as of 2018 in terms of GDP (PPP) per capita.

Amnesty International (2016) also reports that dangerous working conditions are an immense problem in artisanal cobalt mining. They describe that workers seldom use protective equipment and could, therefore, for instance, develop fatal lung diseases by being exposed to cobalt dust. Workers are also more exposed to accidents, such as tunnels collapsing, due to insufficient safety precautions (Amnesty International, 2016).

Many households in the DRC are, nevertheless, dependent upon artisanal mining, and eliminating it could, thereby, cause serious negative economic impact for these households, which, in turn, can increase the prevalence of child labor (Faber et al., 2017). Hence, solving the problems related to artisanal cobalt mining is a complex task that requires not only addressing the human rights abuses that are occurring in the mines, but also the underlying issue of poverty.

The problems related to cobalt mining in the DRC can be classified as issues associated with social sustainability which, according to Zorzini et al. (2015), include social issues such as human rights, community development and ethical issues, but excludes environmental problems. Hence, automotive firms who are transitioning to electromobility might be able to address issues related to environmental sustainability, but these firms are facing new problems related to social sustainability. However, these two perspectives do not necessarily have to stand in conflict as studies suggest that firms who focus on both environmental and social sustainability tend to be competitive and perform well from a financial standpoint (Carter & Rogers, 2008; Elkington, 1998). Thus, firms transitioning to the EV market should not be deterred by the issues related to cobalt mining, but instead, try to make the transition socially sustainable.

On the other hand, it is arguably not up to the automotive firms to address the social sustainability problems related to cobalt since they do not mine the cobalt themselves, or even buy it directly from the mining companies. The mining companies are thus sub-suppliers of the automotive firms, commonly several tiers away in the supply chain (OECD, 2019). However, there can still be negative consequences for automotive firms if the mining companies perform poorly from a social sustainability standpoint. Even if a company has little control over its suppliers or sub-suppliers, consumers and authorities are likely to hold the focal firm responsible for the actions of its suppliers (Hartmann & Moeller, 2014). For example, at the end of 2019, several tech companies, including Apple, Google and Microsoft, were held accountable for the prevalence of child labor and fatalities in cobalt mines in the DRC, even though none of the companies source cobalt directly from their suppliers (Kelly, 2019). Hence, firms that are procuring batteries for EVs can also be negatively affected if the cobalt in those batteries has been mined under poor conditions.

Alpha, a large automotive manufacturer acting as the case company for this study, expects that the importance of EVs for their business will increase drastically in the coming years. Simultaneously, Alpha is taking steps to increase their sustainability requirements and are, thereby, working towards taking more responsibility in their supply chains. It is thus of utmost importance for Alpha to address the issues related to cobalt mining in the transition to electromobility.

However, managing the sub-suppliers who are causing the social problems related to cobalt is challenging as focal firms generally have inadequate information about sub-suppliers and a limited ability to control them (Wilhelm et al., 2016). This means that the focal firm must delegate some of the responsibility concerned with increasing social sustainability to suppliers or sub-suppliers who then act as agents on behalf of the focal firm. This puts the focal firm in a position where they are exposed to agency problems, which arise when the agent acts in a way to maximize their own utility but that is not in the best interest of the actor delegating responsibility to them, known as the principal (Jensen & Meckling, 1976). Hence, to tackle the issues of social sustainability in the supply chain of cobalt, automotive manufacturers must also address the agency problems that may hinder the improvement of social sustainability.

While the transition to electromobility puts pressure on automotive manufacturers to address the social problems related to cobalt, not much research has been conducted on how to deal with these issues. Compared to the extensive literature on environmental sustainability, less focus has been devoted to the social dimension especially in the context of supply chain management and/or developing countries (Anisul Huq et al., 2014; Carter & Rogers, 2008; Seuring & Müller, 2008; Zorzini et al., 2015). This study contributes to bridging the described research gap while also applying relevant theory to the area, through the use of agency theory and complementary theories, which has been requested by, for instance, Zorzini et al. (2015).

1.2 PURPOSE AND RESEARCH QUESTIONS

The purpose of the study is to investigate what approach an automotive manufacturer can adopt towards socially sustainable sourcing of cobalt. This will be done by, firstly, identifying agency problems that exist in the supply chain of cobalt which impede the development of social sustainability. Secondly, strategies aiming to improve the social sustainability of the sourcing of cobalt will be developed and evaluated based on identified agency problems. The purpose is thereby twofold and leads to the following research questions:

1. What are the agency problems that affect social sustainability in the supply chain of cobalt?
2. What strategies are suitable for an automotive manufacturer to manage social sustainability in the supply chain of cobalt?

To answer these questions, agency theory will be employed as the main theoretical lens. Transaction cost theory and multi-tier supply chain management will be applied as two complementary theoretical perspectives that aim to address issues related to transaction cost trade-offs in the implementation of strategies and supply chain complexity, respectively.

2 METHODOLOGY

This chapter describes the methodology of the study as well as the rationale behind it by presenting the research structure, the research design, research method, data analysis, research ethics, and limitations of the methodology.

2.1 RESEARCH STRUCTURE

This study was conducted as a master thesis during the spring semester of 2020. The study was initiated in January 2020 with a meeting between Alpha's sustainability director, purchasing director, and the authors of the thesis. At this meeting, a broad topic was outlined, which was further refined in the upcoming weeks until initial research questions were formulated. The data collection was initiated during the last week of January to get a general understanding of the topic. The data collection continued with more in-depth interviews throughout February until the middle of March. In parallel with the data collection, a literature study was conducted which formed the basis of the literature review. As a consequence of COVID-19, no contact with Alpha could be held from the middle of March until the middle of May.

2.2 RESEARCH DESIGN

The study adopted an explorative research design as previous research in the investigated area is limited. Explorative research was thus suitable as it can be used to help to understand and assess critical issues of problems while not providing definitive answers (Sreejesh et al., 2014). Using an explorative research design was also necessary as all possible strategies, and all the parameters they were evaluated upon, were not known to the researchers beforehand. This aligns well with the description of explorative research formulated by Sreejesh et al. (2014) where analysis of a problem situation, evaluation of alternatives and discovery of new ideas are listed as the main reasons for adopting explorative research. Saunders et al. (2009) point out that explorative research initially allows for a broad focus that progressively becomes more focused as the research progresses. It was thereby an appropriate design as it brought the opportunity to gain an overall understanding of the issues in the cobalt supply chain and thus allowed for a more precise problem formulation at a later stage, and progressively more focused research.

The study was carried out as a single case study at Alpha. A case study involves researching a particular problem in its specific context and is suitable when exploring problems that affect one or more organizations (Adams et al., 2014; Saunders et al., 2009). Case studies are furthermore most often used in explanatory and explorative research due to its potential to answer questions such as "what?", "how?" and "why?" (Saunders et al., 2009). These characteristics are compatible with the research questions for the thesis, and thereby forms the rationale behind the choice of research design.

A qualitative research approach was adopted in the study which, in contrast to its quantitative counterpart, is not data-centric and thereby has the ability to generate richer data by having the advantage of observing the respondents (Adams et al., 2014). Due to the explorative nature of

the research together with the open-ended research questions, a qualitative approach was most compatible with its flexibility to adapt to different situations, as described by Sreejesh et al. (2014).

A research project's relation to theory can be divided into two approaches: deductive and inductive. With the deductive approach, the study is designed to test a hypothesis whereas, with the inductive counterpart, a theory is formulated as a result of the data analysis (Saunders et al., 2009). To fulfill the objectives of this study, the authors needed to understand how agency problems can hinder sustainable procurement for an automotive manufacturer and what strategies can be deployed to overcome these issues. This study is thereby inductive, as it aims to understand the nature of the problem and how it can be solved, which is in line with Saunders et al. (2009) who describe the inductive approach as a way to understand the situation and formulate a theory through analysis. Even though the study overall was of inductive nature, elements of the deductive approach were used when constructing the strategies as this was more of a hypothesis-driven analysis, which is described in more detail in section 2.4. Hence, the inductive approach of the study has been combined with deduction in parts of the analysis. This aligns well with Saunders et al. (2009), who advocate for a combination of deduction and induction in the same piece of research.

2.3 RESEARCH METHODS

This section describes the methods used in the study to gather and analyze data. The first subsection describes how the literature study was conducted while the subsequent parts describe the methods that have been used to collect empirical data.

2.3.1 LITERATURE STUDY

The literature study for the thesis covered articles in scientific journals with mainly three different theoretical perspectives: agency theory, transaction cost theory and sustainable supply chain management. The literature study started through a search for relevant literature based on the research topic given by Alpha. Initially, this resulted in literature within sustainable supply chain management while the main theoretical lens, in the form of agency theory, was derived later on through consultation with the thesis supervisor. Transaction cost theory was identified as a suitable theoretical lens for the thesis through studies of literature in social sustainability, where transaction cost theory is a widely adopted theoretical lens. To get a holistic view of literature in the three areas, both literature that were more conceptual in nature and literature that applied the theories through studying empirical data were considered. For the same reason, a combination of older and more recently published articles was studied. The applied literature was narrowed down so that only literature that applied the theories in an area relevant for the thesis, for instance sustainability, were considered.

Relevant literature was found through a combination of keyword searches and through references in previously studied literature. The credibility of the literature was mainly evaluated based on three different dimensions: number of times the article had been cited, the ranking of the scientific journal, and whether the article had been cited by other credible literature. In terms of the number of citations, 100 citations were considered as a minimum for credibility. Evaluation

based on the ranking of the scientific journal was conducted through Scimago Journal Rankings (www.scimagojr.com). These dimensions were used in a complementary manner, meaning that an article who lacked credibility according to one dimension could be compensated by credibility according to another dimension. An article with a low number of citations could, for instance, be compensated if it were cited by another credible article used in the study.

2.3.2 INTERVIEWS

A total of ten interviews were held during the study to collect empirical data, as shown in Table 2.1. Eight of these interviews were held internally with employees at Alpha and two were held externally. Relevant persons to interview were selected either through recommendation by the supervisor at Alpha or through recommendation by a previous interviewee.

Although none of the interviews were solely related to one topic, they all revolved around one main theme. In general, the data from the interviews served as either contextualizing or as input to the development of the strategies, depending on the topic of the interview. Interviews 1, 3 and 8 served as both contextualizing and input to the development of strategies as the main topic was the procurement of cobalt in terms of both how the process currently works at Alpha and how it can be done in the future. Interviews 4, 5 and 7 focused predominantly on the technical aspects of the batteries and their production process and therefore mainly functioned as contextualizing. Interviews 2, 6, A and B provided input for strategy development as the main topic was responsible sourcing strategies. More specifically, the topic of discussion during these interviews was, for instance, responsible sourcing strategies that had been adopted for other products or firms as well as the interviewees' general thoughts on the applicability of different strategies. The main topic of the interviews was generally known to the researchers before the interview but to validate the main topic and identify subtopics, the interviews were summarized directly after they had been conducted where information was categorized into different topics. The researchers also identified new questions based on the information from the interview, after the interview had been conducted.

Both unstructured and semi-structured interviews were conducted based on the definitions by Sreejesh et al. (2014). They describe unstructured interviews as being similar to a normal conversation, while a semi-structured interview is guided by the interviewer to a larger extent through keeping the interview limited to the topic relevant for the research, although allowing some flexibility. These interview methods can be contrasted by standardized interviews which, according to Sreejesh et al. (2014), are based on a carefully constructed sequential order of questions. A standardized interview approach was considered infeasible due to the explorative nature of the study. The choice between an unstructured or semi-structured approach was based on what information the researchers had before the interview. A semi-structured approach was generally desired to keep a relevant focus for the interview, and thereby maximizing the output from it, but not always possible due to lack of, or inaccurate, information regarding the interviewee's knowledge.

ID	Date	Job Position	Main topic	Type of interview	Duration
Internal interviews					
1	2020-01-30	Project buyer	Procurement of cobalt	Unstructured	30 min
2	2020-02-18	Project buyer	Responsible sourcing strategies	Semi-structured	60 min
3	2020-02-21	Raw material specialist	Procurement of cobalt	Semi-structured	60 min
4	2020-02-27	Cost engineer	Production process of lithium-ion batteries	Semi-structured	60 min
5	2020-03-02	Battery cell specialist	Battery technologies	Semi-structured	60 min
6	2020-03-06	Director sustainability	Responsible sourcing strategies	Unstructured	60 min
7	2020-03-17	Manufacturing tech manager	Production process of lithium-ion batteries	Unstructured	60 min
8	2020-03-18	Project buyer	Procurement of cobalt	Semi-structured	40 min
External interviews					
A	2020-03-03	Managing director at a responsible sourcing service provider	Responsible sourcing strategies	Unstructured	60 min
B	2020-03-23	Executive director at a European business network for corporate sustainability and responsibility	Responsible sourcing strategies	Semi-structured	30 min

Table 2.1: Interviews conducted for collection of data for the thesis.

2.3.3 WORKSHOPS

The authors participated in three workshops, as shown in Table 2.2, which functioned as complements to the interviews by allowing for multiple perspectives as people at different positions and at different companies discussed issues jointly. The possibility for the researchers to ask questions during the workshops was, however, usually limited. The first workshop was held internally at Alpha regarding their current sourcing approach of conflict minerals (tin, tungsten, tantalum and gold) and cobalt. The second workshop, also held internally at Alpha, focused on strategies for traceability of raw material with a focus on blockchain technology and anomaly detection. In the third workshop, arranged by SIDA, multiple corporations in different industries participated to discuss how to address the issues of cobalt mining in the DRC.

Workshops			
ID	Date	Topic	Duration
1	2020-02-05	Sustainable sourcing of minerals	30 min
2	2020-03-09	Traceability of raw materials	120 min
3	2020-03-16	Cobalt mining in the DRC	240 min

Table 2.2: Workshops participated in for collection of data for the thesis.

2.3.4 SECONDARY DATA

In addition to the primary data collected by the researchers, secondary data, which had not been collected specifically for this study, was used. Several sources of secondary data were used, which is summarized in Table 2.3, originating both from Alpha and from outside sources. Secondary data must be used carefully as it may have been collected for a purpose that does not match the purpose of the study being conducted (Saunders et al., 2009). For this reason, only secondary sources that was recommended by interviewees were used in the study. The secondary data proved to be particularly useful to understand the issues in the DRC as well as the complexity of the supply chain as organizations, such as OECD and Amnesty International, has conducted detailed reports on this topic, which would be difficult for the researchers to gather directly.

Secondary data documents					
ID	Organization	Authors	Year	Title	Topic
1	OECD	N/A	2019	Interconnected supply chains: a comprehensive look at due diligence challenges and opportunities sourcing cobalt and copper from the Democratic Republic of the Congo	Social sustainable issues in the upstream supply chain of cobalt
2	Battery manufacturer	N/A	2016	**********	Complexity of the cobalt supply chain
3	RCS Global	Mitchell, Harrison; Maubrey, Ferdinand; Hardy, Sam & Garrett, Nicholas	2016	The battery revolution: Balancing progress with supply chain risks	ASM formalization project
4	Amnesty International	N/A	2016	"This is what we die for": Human rights abuses in the Democratic Republic of the Congo power the global trade in cobalt	Social sustainable issues in the upstream supply chain of cobalt
5	Trafigura	Johansson de Silva, Sara; Strauss, Tove & Morisho, Nene	2019	The Mutoshi Pilot Project	ASM formalization project
6	Supply chain traceability service provider	N/A	2019	**********	Traceability in the supply chain of cobalt
7	Alpha	N/A	2019	**********	Sustainability in procurement

Table 2.3: Secondary data. For confidentiality reasons, some of the names have been anonymized.

2.4 DATA ANALYSIS

This section describes how the empirical data and literature were analyzed to produce the results presented in chapter 5. The analysis was conducted in two parts where the first part consisted of analyzing the collected data to identify agency problems and strategies, while the second part involved an analysis of identified strategies. The analysis was, for the most part, hypothesis-driven, meaning that the researchers developed hypotheses based on literature and secondary data that were refined through the collection of primary data and/or additional secondary data. The hypotheses revolved around either potential strategies or agency problems as will be described below. However, the second part was finalized by a non-hypothesis driven analysis. The adopted methods for data analysis are summarized in Figure 2.1.

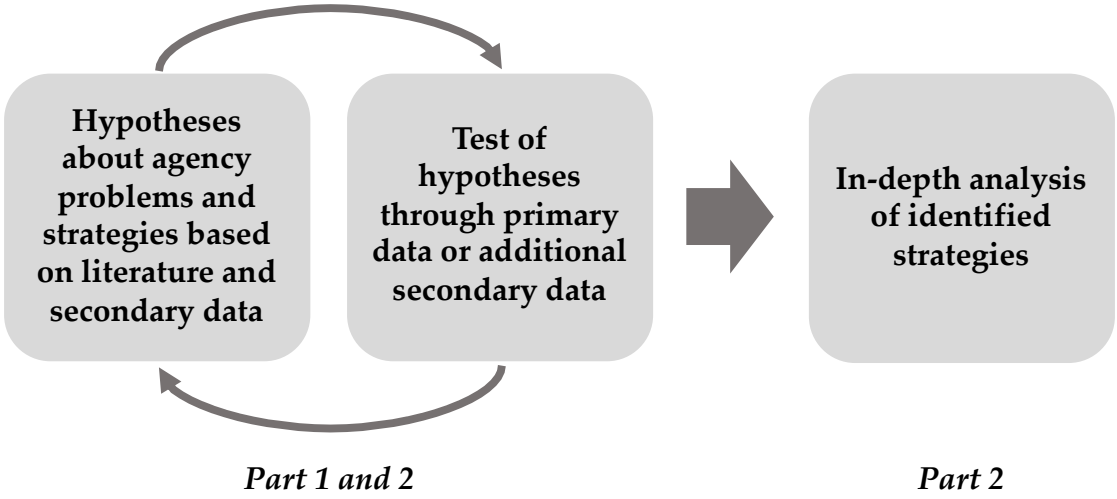

Figure 2.1: Methods used for analyzing data illustrating both the hypothesis-driven approach adopted in the first and second part of the analysis and the non-hypothesis driven approach adopted only in the second part of the analysis.

The first part of the analysis started with the researchers developing hypotheses on potential agency problems and strategies. Hypotheses for agency problems were developed through combining the descriptions of agency problems from the literature with contextual descriptions of the cobalt supply chain from secondary data, which meant that the researchers could form hypotheses on how agency problems were distributed throughout the supply chain. Similarly, hypotheses on strategies were developed through both an examination of how the literature suggested that agency problems or issues related to sustainability could be managed and an investigation of strategies described in the secondary data, for instance in terms of strategies adopted by other companies or recommendations by the OECD. The hypotheses on agency problems and strategies were then continuously revised as primary data or additional secondary data were collected. During the interviews, this meant that the researchers asked questions to develop a deeper understanding of the agency problems or to get suggestions from the interviewee on possible strategies.

The hypothesis-driven approach was utilized during the second part of the analysis as the researchers identified the potential pros and cons of the strategies, mainly based on literature. This was done in parallel with the first part of the analysis, meaning that the pros and cons of a strategy were hypothesized immediately after the strategy had been identified. These hypotheses were then tested during the collection of primary data, especially through asking questions to interviewees to develop a deeper understanding of the suitability of the strategies. The identified strategies were further analyzed more in-depth at a later stage by applying the theories from the literature review. This allowed both for a thorough evaluation of specific strategies and a possibility to compare the main features of them. The strategies were also analyzed through a deeper investigation of the empirical context at this stage to determine the level of suitability of the strategies for automotive manufacturers. The analysis of the strategies led to a conclusion in the form of a strategy recommendation based on different features of the firm implementing the strategy.

2.5 RESEARCH ETHICS

Research ethics is referred to as "the appropriateness of your behaviour in relation to the rights of those who become the subject of your work, or are affected by it." (Saunders et al., 2009, p. 183). Vetenskapsrådet (2002) describes four main requirements to follow when conducting ethical research: information, consent, confidentiality and usage. The first requirement, information, stresses the importance of the researchers to inform the participant of the objective and scope of the study. The second requirement, consent, refers to that the participant in a study has the right to decide over their participation and should be able to discontinue participation at any time. The third requirement, confidentiality, describes that all information on the participants must be treated with the utmost confidentiality and be secured in a manner that ensures that no unauthorized person can access them. The fourth and last requirement, usage, states that the collected data is only allowed to be used within the limits of the research and not for commercial use or other non-scientific purposes.

The researchers have followed these requirements throughout the study by ensuring that the interviewees were informed of the scope of the study before the interview has started and by allowing the interviewees to discontinue the interview. All data from the interviews were treated with confidentiality by having both the case company's and the interviewees' names anonymized in the report and by only using the information gathered in the interviews within the scope of the study.

2.6 DISCUSSION OF METHODOLOGY

The empirical research of this study is subjected to flaws that limit the conclusions. The fact that the study was designed as a single case study in combination with the qualitative nature of it might cause difficulties in generalizing and replicating the results, as pointed out by Woodside (2010). The generalizability of the study is also affected negatively by the relatively low number of interviews and the fact that a majority of the interviews were held internally at Alpha. The authors initially planned to hold interviews with firms further up in the supply chain but due to the sensitive nature of ongoing negotiations with suppliers, this was not possible. More interviews were also planned to be held internally at Alpha, but due to layoffs caused by the global pandemic COVID-19, these interviews were forced to be canceled. These interviews were planned to provide input from the buyers and the sustainability director at Alpha which would be used when evaluating the developed strategies. The evaluation of the strategies has instead been based on data already collected from Alpha but relies more on secondary data and literature than originally planned.

The interviews have, in most cases, not been selected by the researchers, as experts in the field and business practitioners have guided the researchers towards individuals in relevant positions or with relevant knowledge. This is due to the explorative nature of the study which prevented the researchers from making detailed plans of how the data were to be collected at an initial phase of the study. This might create difficulties when trying to replicate the study, even though sections 2.3 and 2.4 describe in detail how the data was collected and analyzed. However, as the replicability of the study might be challenging, the authors aimed to increase its reliability and

validity through triangulation of data, meaning that two or more independent sources of data were used to corroborate the findings whenever possible. Data from interviews have been triangulated with literature or with interviews with a person in a different position, which is an important measure to take in order to make sure that the data is correct and interpreted correctly, as pointed out by Saunders et al. (2009). However, the fact that the research area for the thesis is relatively unexplored, with few scientific studies, as well as a low number of applied cases, has limited the extent of the triangulation.

3 EMPIRICAL CONTEXT

This chapter presents a context for the study, based on empirical data, which is essential to be able to answer the research questions. The chapter is divided into two main parts where the first part describes the supply chain of cobalt and the second part describes automotive manufacturer's dependence on cobalt for their EV-batteries.

3.1 THE SUPPLY CHAIN OF COBALT

This section describes the supply chain of cobalt from the DRC. While cobalt also originates from other nations, the DRC is the largest producer as well as the nation in the cobalt supply chain with most apparent social problems, and thereby in focus in this thesis. The supply chain of cobalt in this section, therefore, refers to the supply chain of cobalt which originates from the DRC. The supply chain of cobalt consists of approximately five to nine steps from mining to automotive manufacturers. Adding to this complexity, the material from different suppliers is often mixed at different stages in the supply chain, making it difficult to track the origins of the material. On a high level, the supply chain of cobalt consists of four steps, as seen in Figure 3.1.

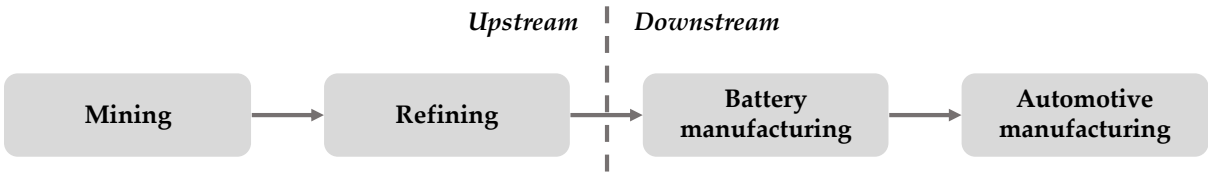

Figure 3.1: High-level overview of the cobalt supply chain for EV-batteries.

3.1.1 THE UPSTREAM SUPPLY CHAIN OF COBALT

The following details of the upstream supply chain of cobalt are derived from the report *Interconnected supply chains* by OECD (2019), internal interview 1,2 and 8 and external interviews A and B. The upstream supply chain of cobalt consists of all stages from mining to fine refining. There are, however, multiple possible ways the material can flow in the supply chain, meaning that the origins of the cobalt and the actors who handle the material can differ. Figure 3.2 shows an example of a supply chain structure where the material can flow in different ways. The mining activities in the DRC can be divided into large-scale mining (LSM) and artisanal and small-scale mining (ASM). ASM can be further divided into informal and formalized.

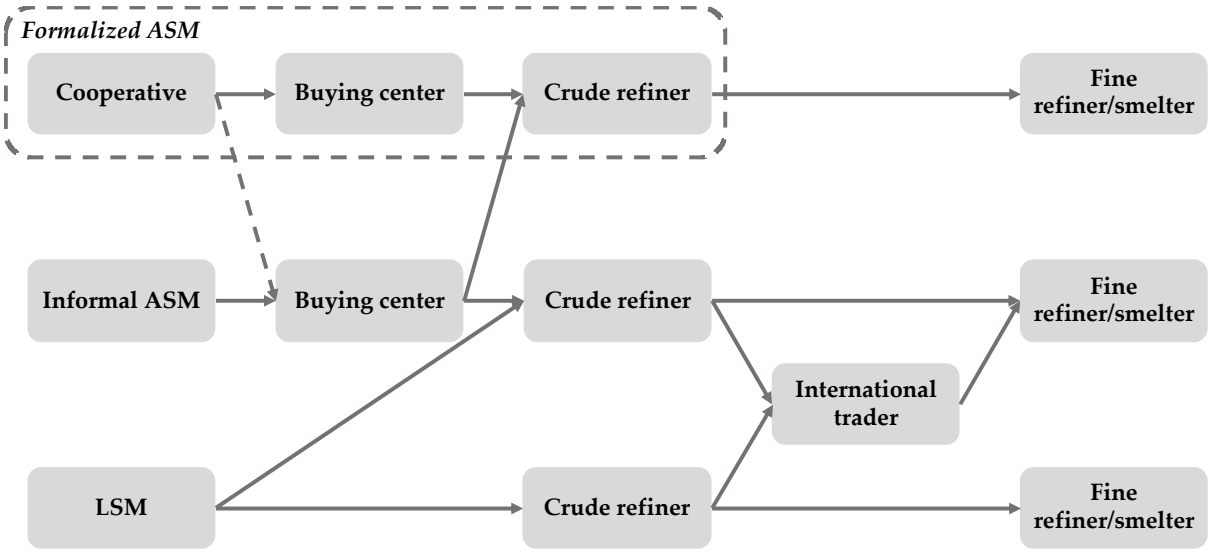

Figure 3.2: Example of the upstream supply chain of cobalt.

LSM produces the majority of the cobalt in the DRC with approximately 70-80 % of the cobalt production in the country. LSM operations in the DRC is dominated by 12 companies, of which seven are Chinese owned. The LSM companies have varying levels of vertical integration as described by OECD (2019):

> Some of the largest LSM companies operating in the DRC have integrated, mainly closed-pipe supply chains in which the mine operator also owns and operates the facilities that process or refine ore into products for export, typically copper cathodes and cobalt hydroxide. Such companies maintain custody of the minerals and mineral products from production through to export, and sometimes beyond. (p. 20)

However, other supply chain structures are also common where LSM companies sell their material to third party crude refiners and/or purchase ASM material as a complement to their own production.

Informal ASM, which produces 20-30% of the DRC cobalt, has no recognition from mining authorities. ASM functions as a buffer to cope with demand fluctuations since its production can be scaled up or down quickly as miners switch between extracting cobalt and other minerals, such as copper, depending on the price. Informal ASM can broadly be divided into three categories: ASM operations on active LSM concessions, ASM operation on abandoned LSM concessions, and ASM in residential areas. As informal ASM lies outside the legal framework for mining in the DRC, it is more exposed to human rights abuses, including child labor, dangerous working conditions, and various forms of corruption.

Formalized ASM contributes to only a small part of the total DRC cobalt production with five recognized mining sites, which are ASM-LSM cooperations or standalone sites. Formalized ASM sites are managed by cooperatives in which the artisanal miners must become members. Actions to improve the health and safety of the miners through, for instance, safety gear and on-site medical services have been taken at formalized ASM sites and it is, therefore, recognized by mining regulatory authorities. A fence commonly encloses the formalized ASM site, with entry

points at which controls of, for example, age and sobriety of the workers are done as well as measures to reduce smuggling of minerals out of the premise. LSM actors sometimes sources material from formalized ASM sites, in which case they must have a commercial agreement with the cooperative. The LSM actor is then given exclusive purchasing rights and must in return make financial contributions to the ASM actor, such as paying cooperative management fees, operate buying stations on the site and provide transport of the material from the buying station. The miners at formalized ASM sites are usually paid less per kilogram of cobalt compared to the informal counterpart, as the operator of the formalized ASM site needs to compensate for the investment costs associated with the aforementioned measures. However, the formalized sites usually achieve higher efficiency and reduce costs of corruption, which means that the miners can receive a similar compensation in formalized ASM as in the informal ditto. Formalization projects of ASM have also been impacted by the drop in the price of cobalt as described Johansson de Silva et al. (2019) in their report of a formalization project:

> In response to a serious drop in turnover and lack of liquidity, certain project deliverables were withdrawn by Chemaf [a mining company], such as regular and frequent payments to the miners, stripping of the mine site, and replacement of worn or lost safety equipment. (p. 15)

At the **buying centers**, also commonly referred to as *dépôts*, the cobalt is weighed and bought in accordance with a regularly updated price list visible to the seller. The buying centers can be located on the ASM operation, just outside of it or near towns and larger cities. Only Congolese nationals are allowed to operate buying centers but in practice, most of them are operated by foreigners, most commonly Chinese. Formalized ASM often has on-site dépôts owned by an actor further downstream, such as smelters.

Crude refiners, also commonly referred to as processors, buy the minerals from the buying centers. The minerals from the buying centers can, for instance, be bought by one cruder refiner with exclusive buying rights on all material from a buying center or be bought by two or more crude refiners. When the cobalt has been refined, it is most commonly transported via truck to harbors in South Africa, Tanzania or Mozambique, before exported further.

Smelters, also known as fine refiners, further refine the cobalt concentrate, commonly to cobalt oxide which downstream companies process before it enters battery cell production. There are only approximately 10 companies handling the vast majority of smelting operations in the cobalt supply chain, of which a large majority are Chinese. Some smelters have vertically integrated operations, either by ownership or partnership, spanning crude refiners, buying centers and in some cases mines. However, vertically integrated companies also commonly source cobalt concentrate from sources other than their own assets, including ASM. The smelter also commonly buys the material from an **international trader**, who exports the cobalt from the DRC. These traders, who primarily are based in Europe, are few in numbers and handle large portions of the cobalt export.

3.1.2 THE DOWNSTREAM SUPPLY CHAIN OF COBALT

The main downstream actors in the cobalt supply chain and their activities are presented in this section. Since the main focus of this study lies in solving issues in the upstream of the supply chain, less attention will be devoted to the downstream part of the supply chain. However, the fact that there are many intermediary steps between the upstream supply chain and automotive manufacturers may affect their ability to resolve the upstream issues negatively. As in the upstream of the supply chain, there are different variations of the downstream with varying levels of complexity. The illustration in Figure 3.3 shows the downstream in the way that is most relevant for this study where only the main actors are included, and alternative material flows are excluded for the sake of simplicity. Information for this section mainly comes from internal interviews 4,5 and 7 as well as secondary data document 2.

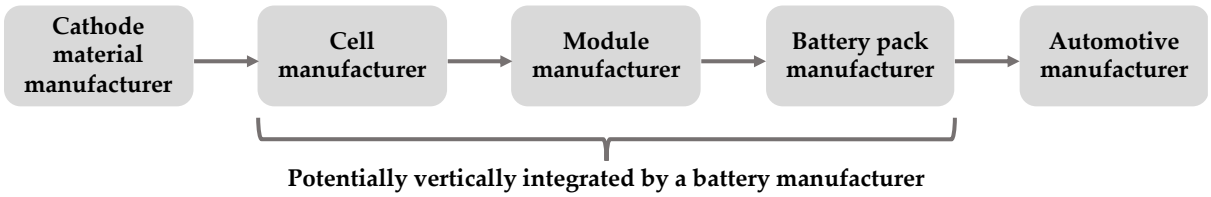

Figure 3.3: Actors in the downstream part of the cobalt supply chain for EV-batteries.

Cobalt supplied from smelters is turned into cathode material when processed downstream actors. The cathode material is a powder with a mix of different materials where cobalt is one of the materials. Turning cobalt from smelters into cathode material is a process consisting of multiple steps that might be performed by different actors. However, Figure 3.3 only shows one actor, a cathode material manufacturer, as potential additional actors are assumed to have low relevance for this study.

The cathode material is supplied to a cell manufacturer who produces battery cells for EV-batteries and potentially other batteries, for instance to the consumer electronics industry. The cell manufacturers produce both cathodes and anodes for the battery cells in the same facility, but with separated production flows. The cathode production is seen as core business for the cell manufacturer since the cathode has a decisive role in determining the characteristics of the battery, for instance in terms of its capacity. Once the battery cells have been produced they are aggregated first into battery modules and then into battery packs before they are supplied to automotive firms. Cell manufacturing, module manufacturing, and battery pack manufacturing may in some cases be vertically integrated activities performed by a battery manufacturer.

Alpha intends to source the majority of their batteries from one large battery manufacturer, hereafter referred to as company X, who supplies batteries to many different firms in different industries. The volume of batteries supplied to Alpha will stand for a small portion of the total amount of batteries produced by the company X. Even though there is some uncertainty with regards to whether company X will produce the modules and battery packs as well for Alpha, apart from the battery cells, Alpha will maintain direct communication with company X and place orders from them. Company X can thus be seen as a first-tier supplier to Alpha.

3.2 COBALT DEPENDENCE

This section describes the current dependence on cobalt for EV-batteries, and how this might change in the future, for both automotive manufacturers in general and specifically for Alpha. The sources for the section include internal interviews 1, 4 and 5, external interview A, and secondary sources, which will be highlighted throughout the section.

The cathode in the current EV-batteries has a relatively small share of cobalt at less than ten percent, which is lower compared to previous generations. The amount of cobalt has thus been reduced and replaced with higher levels of nickel. This has led to an increased energy density, in terms of stored energy amount per unit mass, of the batteries and lower material costs. The social problems related to the cobalt supply chain has also been driving the cobalt reduction. There are, however, two main issues with reducing the cobalt amount: safety and battery life. Cobalt provides a stabilizing feature to the batteries and, therefore, decreases the risk of overheating, which means that there are safety issues related to reducing the cobalt amount. Lower levels of cobalt also imply a reduction in battery life as measured by the number of possible recharges. Decreased battery life is, however, less of an issue because it is largely offset by the increased energy density, which means that battery life as measured in number of years is almost the same even with lower levels of cobalt. It is possible that future EV-batteries will contain even lower amounts of cobalt compared to today's batteries or remove it altogether, but it is unlikely that this shift will happen before 2030.

Other than the social issues, the dependency on cobalt also raises concerns from an availability perspective, meaning if there will be enough cobalt supply to meet future demand. Various studies have been conducted on this topic, for instance by Azevedo et al. (2018) who predict that cobalt demand may surpass supply already 2025 depending on the rate of EV adoption and possible future cobalt mining projects. The European Commission projects a large deficit of cobalt supply in 2030 (Alves Dias et al., 2018). There are however other reports which give a different view on the availability of cobalt. Drive sustainability, Responsible minerals Initiative and The dragonfly initiative (2018), for instance, reports that cobalt has a relatively low depletion rate compared to other raw materials. They define the depletion rate as the rate at which the material is becoming unavailable for mining, which takes the cost of extraction, technological capacity, and geopolitical and environmental factors into account.

The interviewees for this study also gave contrasting views on cobalt availability. Interviewee A stated that "it [the availability] is going to be a massive challenge, we have not seen the peak of demand yet". The interviewee further explained that the demand for cobalt will increase dramatically since there are a lot of automotive manufacturers that have strategies for selling EVs in the future but have not started doing so yet. The main issue, however, according to interviewee A, is not whether there will enough cobalt in the ground but if the supply will be able to grow at the same pace as demand. Interviewee 1 did not see cobalt availability as a large cause of concern compared to other battery metals, such as nickel. The interviewee also stressed the fact that Alpha only accounts for a small portion of the total amount of batteries produced by company X. This means that they will be able to supply batteries to Alpha without any risk of cobalt shortage, even if Alpha's actual future EV sales would surpass current projections.

4 LITERATURE REVIEW

This chapter will present the main theoretical lenses used in the study. The aim of the chapter is thereby to give the reader a comprehensive understanding of agency theory, transaction cost theory and sustainable supply chain management with a multi-tier perspective, and how these theoretical lenses are connected. The chapter will also introduce recent findings of studies in the supply chains of minerals with similar characteristics as cobalt.

4.1 AGENCY THEORY

Agency theory is applied in situations where one party, the principal, delegates work to another party, the agent (Eisenhardt, 1989). The agent thus takes decisions on behalf of the principal (Jensen & Meckling, 1976). According to Ross (1973), the principal-agent relationship is a common form of social interaction and can, for instance, be applied to all types of contractual arrangements. Eisenhardt (1989) illustrates the versatility of agency theory by exemplifying issues that it has been applied to, including employee compensation, ownership and financing structures, vertical integration, and more. According to Jensen and Meckling (1976), a fundamental problem with these relationships is that the agent might take decisions to maximize its own utility at the expense of a reduction in the principal's welfare. They, therefore, conclude that there can be a misalignment between how the principal wants the agent to behave and how the agent actually behaves. Eisenhardt (1989) explains that this issue is the agency problem, which arises when there are conflicting goals between the principal and the agent, a form of asymmetric incentives, and because it is difficult for the principal to verify what the agent is doing, a form of asymmetric information. Furthermore, Eisenhardt (1989) claims that there are two main aspects of agency problems, moral hazard and adverse selection. Moral hazard means that the agent does not put in the level of effort that has been agreed upon while adverse selection means that the agent misrepresents his abilities when hired by the principal.

Asymmetric information has for instance been studied by Akerlof (1978) who describes that it affects product quality negatively in buyer-seller relationships as high-quality products are pushed out of the market by low-quality products. Akerlof (1978) claim that asymmetric information exists in these relationships since buyers do not have as much information as sellers have regarding the quality of the product to be sold. More specifically, the buyer cannot tell whether the product is of high or low quality to the same extent that the seller can. Akerlof (1978) argues that this leads to high and low-quality products being sold at the same price and sellers, therefore, become reluctant to sell high-quality products as they do not receive any premium for doing so. Consequently, the average product quality in the market becomes deteriorated and the market size decreases.

According to Eisenhardt (1989), the objective of agency theory is to determine how a contract between the principal and agent can be designed to best deal with the problems of asymmetric information and asymmetric incentives. Eisenhardt (1989), distinguishes between two types of contracts for governing principal-agent relationships: outcome-oriented and behavior-oriented. Furthermore, she describes the advantages and disadvantages of these contracts that arise under certain circumstances. An outcome-oriented contract can be a good way to align the incentives

and behaviors of the agent with those of the principal as the agent is rewarded on outcomes specified by the principal, an example being commissions paid to salespeople. There could, however, be some level of uncertainty related to the outcome as external factors, which the agent cannot control, might affect the end result. Hence, the agent might be acting in accordance with the principal's intentions but still not produce the agreed-upon outcome. It can thus be difficult for principals to tell whether an outcome-based contract actually makes the agent behave in line with their intentions while the agents, on the other hand, must take on the risk of being negatively influenced by external factors. The alternative is to reward the agent based on their actual behavior, which is the case for behavior-oriented contracts. However, with this type of contract, the principal must know what the agent is doing, meaning that information asymmetries must be eliminated. Eisenhardt (1989) suggests investing in information systems could be a way to remove information asymmetries. An example could be to develop comprehensive reporting procedures for employees to be used as a basis for salary increases.

Jensen and Meckling (1976) describe that, in addition to measures taken by the principal to reduce information and incentive asymmetries, similar to those described by Eisenhardt (1989), the agent can also make efforts to assure the principal that he will not take actions that deviate from the principal's intentions, for instance by agreeing to compensate the principal in case this would happen. However, Jensen and Meckling (1976) claim that even if both parties take measures to reduce the negative aspects of the relationship, it is still difficult to fully eliminate them. They, therefore, conclude that the cost of a principal-agent relationship is the sum of the costs associated with measures taken by both the principal and agent to minimize agency problems, as well as the residual loss in the principal's welfare.

One area of research where there has been an increasing interest in agency theory is supply chain management (Fayezi et al., 2012). According to Ketchen and Hult (2007), agency theory is oftentimes applicable to relationships between actors in supply chains as a delegation of authority is common in this setting. Furthermore, they explain that the sequential execution of activities in supply chains implies that an actor can be principal in relation to some actor in the supply chain, and agent to another. With this in mind, they suggest that an agent who acts opportunistically can be punished by other firms who act as agents on their behalf. Hence, a sort of propagation of opportunistic behavior can occur in supply chains. To avoid this, Ketchen and Hult (2007) suggest that aligning incentives between supply chain actors is important, for instance through reward structures. This goes in line with Halldorsson et al. (2007) who advocate setting up contracts between supply chain participants with a balance of penalties and rewards as a way to align incentives.

Narayanan and Raman (2004) present three different solutions to align incentives in supply chains: contract-based, information-based and trust-based. The contract-based solution is similar to that proposed by Ketchen and Hult (2007) and Halldorsson et al. (2007), namely that a firm can form a contract with a supply chain partner that rewards or penalizes the partner based on their outcome. The information-based solution entails collecting more data by monitoring more of the partner's business variables, which can be a way to make hidden actions or hidden information visible. Lastly, the trust-based solution aims at reducing the need for formal contracts by instead developing trust between supply chain actors.

Norrman (2008) illustrates through two cases studies how buyers and suppliers can move towards more contract-based solutions to align incentives and share risks between them. The studied companies handle demand, supply, and material cost uncertainty through different risk-sharing mechanisms that are incorporated in buyer-supplier contracts. An example of such a mechanism is that the buyer commits to a minimum purchase quantity several months ahead of time, which means that they take on more demand risk than before. Norrman (2008) concludes that these well-defined contracts reduce uncertainty and support the development of long-term trusting relationships, which means that contract-based and trust-based solutions can actually work as complements rather than substitutes.

The importance of incentive alignment, as put forth by previously mentioned scholars, has been contested by Morgan et al. (2007) who study opportunism among focal suppliers based on empirical data from U.K. supermarket retailers. They define focal suppliers as those suppliers who have significant input into the retailer's management over a category of products. The authors find that while retailers can monitor focal suppliers to limit their opportunistic behavior, punishing focal suppliers who act opportunistically does not appear to have any effect. Since punishment could be seen as an incentive to not act opportunistically, they conclude that their findings deviate from agency theory's emphasis on incentive alignment. Morgan et al. (2007) do however find that supplier opportunism has a negative economic impact in supply chains, even beyond the dyadic relationship between retailer and supplier, which is in line with other literature on agency theory.

4.2 TRANSACTION COST THEORY

The transaction cost theory originates from the 1937 article *The Nature of the Firm* by Ronald Coase and was later developed by Oliver Williamson. Coase (1937) questioned why resources within firms are allocated without the influence of the price mechanism, as it would be on a marketplace. He concluded that there must be costs associated with using the price mechanism, which includes, for instance, the cost of discovering relevant prices and the cost of negotiating contracts for transactions on the market, and that these costs can be reduced within firms. Hence, as explained by Coase (1937), firms arise since they are able to carry out certain tasks at lower cost than markets can.

The cost of using the price mechanism described by Coase is what Williamson (1981) refers to as transaction costs, which he sees as frictions in economic exchanges between two parties, for instance, in the form of misunderstandings and conflicts. He adds that these costs vary between transactions, meaning that some transactions are easier to handle than others. With this in mind, Williamson (1981) explains that the purpose of transaction cost analysis is to decide how to govern different transactions and, similar to Coase (1937), proposes that there are two fundamental governance structures for transactions, markets and firms, where the latter is also referred to as hierarchy. In other words, as put forth by Grover and Malhotra (2003), transaction costs could be too high under certain circumstances, in which case hierarchy governance could be superior.

Williamson (1981) describes that transaction cost analysis is based on two assumptions of human behavior, bounded rationality and opportunism, which explain why market governance through contracting can be a costly way to govern transactions in certain situations. Bounded rationality implies that humans have limitations when it comes to formulating and solving complex problems and processing information. Hence, transaction cost analysis does not assume that humans are completely rational, as neoclassical economics does, but not that they are irrational either, rather that they intend to act rational but are restricted from fully doing so. In terms of transactions, bounded rationality means that it is impossible to form contracts that cover all important aspects of the transactions and as a result, all contracts to some extent incomplete.

However, as Williamson (1981) claims, bounded rationality alone cannot explain why contracting might be infeasible, as the assumption of human opportunism is required as well. Williamson (1981) defines opportunistic behavior as "self interest seeking with guile" (p. 554). He furthermore explains that if a scenario without opportunistic human behavior is assumed and one of the contracted parties, the agent, would run into an unexpected event (as a result of the incomplete nature of contracts) they would act in the interest of the other party, the principal. This would not be the case if the agent were opportunistic, as he might then instead use this loophole in the contract to his own personal advantage without telling the principal, given Williamson's (1981) definition of opportunistic behavior. Hence, as Williamson (1981) describes it, contracting is problematic as some agents might act opportunistically (and the principal cannot know ex-ante if the agent will behave opportunistically or not) and because it is impossible to construct a complete contract due to bounded rationality. This is in line with John (1984) who argues that curbing opportunistic behavior is partly the reason why transactions might take place in organizations as opposed to on a marketplace.

Moreover, Williamson (1981) explains that whether contracting will be successful is also dependent upon the characteristics of the transaction, which can be determined by using a number of dimensions, the two most important being uncertainty and asset specificity. According to Williamson (1981), asset specificity describes whether a transaction requires specialized, idiosyncratic, investments. Grover and Malhotra (2003) explain that these asset-specific investments have little or no value outside the relationship between the parties involved in the transaction. Furthermore, Williamson (1981) states that there are different types of asset specificity out of which physical asset specificity, e.g. investments in specialized equipment, and human asset specificity, e.g. training of employees (Grover & Malhotra, 2003), are the most meaningful. Williamson (1981) asserts that asset specificity results in the parties being locked into the transaction for a substantial period of time. A buyer can for instance not alternate between suppliers if asset-specific investments have been made towards one supplier as this would result in excessive costs, and the same reasoning can be applied to the supplier. Williamson (1981) argues that transactions with high asset specificity are most efficiently governed by internal organizations whereas markets are superior at governing transactions with low asset specificity.

According to Grover and Malhotra (2003), uncertainty in transaction cost theory describes unexpected changes in circumstances surrounding a transaction. These uncertainties can be divided into two categories: Those that affect the formulation of contracts, which can be referred to as ex-ante or environmental uncertainties, and those that affect the ability to verify compliance

after the contract has been formulated, which can be referred to as ex-post or behavioral uncertainties. More specifically, environmental uncertainty refers to unpredictability outside of the contractual relationship, for instance with regards to technology or demand volumes, while behavioral uncertainty deals with issues related to information asymmetry and measuring performance.

Clemons et al. (1993) suggest that transaction costs can be calculated as follows:

Transaction costs = coordination cost + operations risk + opportunism risk

According to Clemons et al. (1993), *coordination cost* can be understood as costs associated with exchanging information between parties and incorporating that information into decision processes. This information exchange might, for instance, revolve around the transfer of information on products, such as prices and availability, and demand. Furthermore, Clemons et al. (1993) describe that *operations risk* can be seen as a result of information asymmetry and refers to the risk that one party in the transaction withholds or misrepresents information to the other party. It might also be that one party underperforms with regards to their agreed-upon responsibilities. An example of operations risk could be that one party delivers a product with inferior quality if it knows that the other party cannot accurately measure the product quality (note the similarities with Akerlof (1978) described in section 4.1). Lastly, Clemons et al. (1993) explain that *opportunism risk* refers to risks that arise as a result of one party having more bargaining power in relation to the other party. An example of this is when one party supplies a product to the other party for which only a limited number of potential suppliers exist, which increases the supplier's bargaining power. The supplier might then exploit this bargaining power by acting opportunistically, for instance by raising prices. Opportunism risk might also refer to a reduction in the bargaining power of one party before and after the transaction has taken place which might be due to one party making asset-specific investments in the other party. Clemons et al. (1993) argue that the party making asset-specific investments becomes vulnerable to demands by the other party, such as price changes, meaning they have no option but to agree on these demands since the asset-specific investment makes them reliant on working with the other party.

Grover and Malhotra (2003) summarize the key propositions of transaction cost theory, based on its assumptions and dimensions laid out by Williamson, as follows:

> Bounded rationality and opportunism give rise to transaction costs. These costs are higher under conditions of high asset specificity and high uncertainty. The most efficient governance mechanism (markets or firm) needs to be chosen to organize economic activity. In general, lower transaction costs favor markets, while higher transaction costs favor hierarchies. (p. 460)

Hence, the assumptions of human behavior (bounded rationality and opportunism) are seen as the root cause behind the existence of transaction costs. How high the transaction cost will be for the given transaction is then determined by its dimensions. In other words, the more asset-specific investments, and the more uncertainty associated with the transaction, the higher its transaction

costs will be. Lastly, the governance structure for the transaction should be chosen depending on how high the transaction costs are. Markets are generally better at managing transactions with low transaction costs while hierarchies are better at managing transactions with high transaction costs.

According to Ketchen and Hult (2007), transaction cost theory is well suited for application in supply chain management as it provides guidance for make or buy decisions. Similar to Grover and Malhotra (2003), Ketchen and Hult (2007) argue that firms should choose the option (make or buy) that minimizes transaction costs. Halldorsson et al. (2007) claim that relationships between actors in supply chains can be seen as a hybrid form of governance that lies in between market and hierarchy. A similar proposition is given by Heide and John (1990) who state that a closer relationship between buyer and supplier implies a shift away from market governance toward bilateral governance. Based on empirical data from OEMs, Heide and John (1990) find that bilateral governance is not desirable in all situations as market governance will likely be preferable from a performance perspective. However, they argue that bilateral governance is advantageous in case there are asset-specific investments that need protection or if there are uncertainties that require adaptation.

Harrigan (1984) addresses different types of governance in the context of vertical integration ranging from non-integration, where the firm has no ownership in the supply chain apart from their own core activity, to full integration, where the firm has ownership of all activities in the supply chain from raw material to retail. She also proposes different forms of vertical integration that lies in between non-integration and full integration, one such option being quasi-integration where firms do not own 100 percent of other firms in their supply chain. Quasi-integration can be arranged in different ways, Harrigan (1984) lists the following alternatives: "cooperative ventures, minority equity agreements, loans or loan guarantees, pre-purchase credits, specialized logistical facilities or 'understandings' concerning customary arrangements" (p. 643). Harrigan (1984) argues that more vertical integration is associated with more risk, higher capital costs and higher exit barriers. She, therefore, suggests that high levels of vertical integration should be used in stable environments where, for instance, demand uncertainty is low, and technology is not evolving rapidly.

4.3 SUSTAINABLE SUPPLY CHAIN MANAGEMENT

While multinational companies face increasing pressures to improve sustainability in their operations, it is not necessarily only a burden for these firms as studies have shown that a focus on sustainability can increase bottom line profits. Elkington (1998) introduced the triple-bottom-line (TBL), people, planet and profit, and suggested that a company needs to be competitive across all three dimensions to flourish. Carter and Rogers (2008) apply the TBL-concept in a supply chain setting by introducing the term *sustainable supply chain management*. Through an extensive literature review, they propose that companies who undertake all aspects of TBL in their supply chain perform better economically than companies who only focus on one or two dimensions.

While much of the research has focused on environmental issues, the social aspect has largely been neglected (Seuring & Müller, 2008). Zorzini et al. (2015) define socially responsible

sourcing (SRS) as the social aspect of the TBL upstream in the supply chain. Studies have linked SRS with purchasing activities, suggesting that purchasing activities can significantly affect the sustainability actions of a firm and its upstream supply chain, while also suggesting a link between SRS and increased financial performance (Carter et al., 2000; Carter & Jennings, 2002). However, much of the research of SRS is still in its infancy and further research is needed to provide clear managerial implications (Zorzini et al., 2015). The current research is also largely focused on developed countries, such as the study by Sancha et al. (2016) who investigated how assessment and collaboration with suppliers affect the social performance of the supply chain. The authors propose that assessment function as a mitigation strategy rather than improving social performance and, therefore, argue that assessment only improves the buying firm's reputation. Collaboration, on the other hand, is shown to directly improve the suppliers' social performance.

One of the few studies of social sustainability in developing countries is a case study by Anisul Huq et al. (2014) which seeks to identify why suppliers in developing countries adopt socially sustainable practices and what facilitates or impede this adoption. The study suggests that external stakeholder pressure and competition for labor are important factors that explain why socially sustainable practices are adopted. However, identified inhibitors of adoption include buyers' reluctance to share costs of implementation, multiple codes of conduct from multiple buyers, suppliers covering up non-compliance and buyers of supplier firms ignoring violations. The identified enablers of adoption of social sustainability were primarily higher prices and larger order quantities. To further facilitate social sustainability, Anisul Huq et al. (2014) calls for a transition from strictly auditing and monitoring suppliers to a combination of monitoring and collaboration by developing the suppliers and building trust. Lastly, Anisul Huq et al. (2014) suggest that the buying firm should not only work with its suppliers who directly supply material or parts to the firm (i.e. first-tier suppliers), but also consider suppliers further up in the supply chain, for a more impactfully implementation of social sustainability in its supply chain.

To engage with suppliers further up in the supply chain, firms need to move beyond the dyadic view between buyer and first-tier supplier and instead develop a multi-tier supply chain perspective when studying longer and more complex supply chains. This is emphasized by Rowley (1997) who suggests that the traditional dyadic view of an organization and its stakeholders is not sufficient as it does not capture all the ties between organizations in a network. Mena et al. (2013) suggest that the network of stakeholders should be seen as a three-tier system or triad, to capture further connections between stakeholders while still maintaining a sufficient level of simplicity. Three types of multi-tier supply chain structures, open triad, transitional triad, and closed triad are described by Mena et al. (2013) based on how information and material move between the firms in the triad. The open triad is described as the traditional view of supply chains where the flow of information and material is linear and follows each other, contrasted by the closed triad which instead links the buyer to its sub-supplier through regular interactions (Mena et al., 2013). Finally, the transitional triad lies between the other two structures meaning that the buyer and sub-supplier communicate with each other, but in a less formal way compared to the closed triad (Mena et al., 2013).

Since companies are ever more concerned with sustainability in their supply chain, they are eager to gain visibility and control further up in the supply chain and are therefore pursuing different tactics to manage lower-tier suppliers. Tachizawa and Wong (2014) have developed a framework with four different types of relationships with lower-tier suppliers to manage sustainability: directly, indirectly through the first-tier supplier, working with a third party and "do not bother". The direct approach includes providing requirements directly to lower-tier suppliers (such as codes of conduct), directed sourcing, and different types of training. The indirect approach instead implies providing requirements to first-tier suppliers. Working with third parties entails collaborations with, for instance, NGOs, competitors or third parties through audits. Lastly, with the "do not bother" approach, the buying firm solely focuses on the first-tier supplier and does not require any information from lower-tier suppliers. Grimm et al. (2016) instead use two dimensions, assessment and collaboration, to categorize the different strategies focal companies use to manage the sustainability of lower-tier suppliers, where assessment infer audits, site visits, et cetera, and collaboration infer training, workshops, corrective action plans, et cetera. Both increased collaboration and assessment is suggested to improve lower-tier suppliers' sustainability, but the first-tier supplier should not be neglected in order to keep the relationship with them (Grimm et al., 2016).

Recently, researchers have studied sustainability in the multi-tier supply chain of minerals. Sauer and Seuring (2019) propose an approach where the supply chain is divided into two segments, upstream and downstream, which should be governed separately to ensure a sustainable supply chain. Sauer and Seuring (2019) suggest that the focal firms, such as automotive manufacturers, should govern the downstream supply chain while smelters should govern the upstream supply chain, since these actors have a relatively high overview of their respective segments. For the smelters, this means that they can guarantee the origins of the minerals. It is also important that direct contact between smelters and focal firms is established to ensure alignment and thereby sustainability in the supply chain (Sauer & Seuring, 2019). Hence, developing a relationship with smelters is a way for the focal firm to guarantee sustainably sourced minerals (Sancha et al., 2019; Sauer & Seuring, 2019). Young et al. (2019) studied how manufacturers engage with sub-suppliers in the context of conflict minerals (tungsten, tin, tantalum and gold) and found that focal firms collectively are engaging with smelters who may or may not be sub-suppliers to all the focal firms, to increase visibility and sustainability in the supply chain.

4.4 AGENCY AND TRANSACTION COST THEORY IN SUSTAINABLE SUPPLY CHAINS

Transaction cost theory and agency theory has both proved to be useful to understand how focal firms can improve social sustainability in their supply chain. The following section presents empirical studies where agency theory and/or transaction cost theory have been applied in sustainable supply chain management, with an emphasis on studies which focus on the social dimension of sustainability.

Jiang (2009) uses the tools of transaction cost theory in his study of the implementation of supplier code of conduct. He explores how cost pressure, production complexity, contract

duration together with either a market or hierarchy governance affects supplier commitment to social sustainability. Jiang's findings suggest a positive relationship between hierarchical governance and supplier compliance, although requiring increasing asset-specific investments. Relying on market governance is shown to not be sufficient to gain commitment from suppliers as it creates a system where the supplier aims to only pass the audit rather than addressing the underlying problem. Lastly, Jiang (2009) suggests that buying firms should have a more cooperative approach to its suppliers and provide support to gain gradual improvements, rather than a strict market governance style where non-compliant suppliers are removed from their supply chain.

Transaction cost theory is applied in the study by Anisul Huq et al. (2014) to analyze the enablers and inhibitors of the implementation of socially sustainable practices in developing countries. They suggest that high asset specificity can explain buyers' reluctance to make human capital investments, such as training suppliers, since high asset specificity implies high transaction costs. They further propose that supplier opportunism, such as "mock compliance", can be found in social sustainability implementations, which increases transaction costs as monitoring and enforcements might be necessary. Lastly, Anisul Huq et al. (2014) conclude that implementing socially sustainable practices for suppliers in developing countries implies high transaction costs and, therefore, suggest that a hierarchical governance structure is beneficial. Market governance would, in this situation, mean that social sustainability would only be enforced through selecting an appropriate supplier based on an initial audit, which authors see as insufficient due to potential supplier opportunism and the fact that the audits are subject to bounded rationality.

Wilhelm et al. (2016) instead use agency theory to explore sustainability compliance in a multi-tier supply chain. The authors use the notion of double agency, as they propose that the first-tier supplier act as an agent towards the buying firm, as they must assure sustainability in its own operations, but also has a secondary agent role as it can have a large impact of the sustainability of the whole supply chain through decisions such as selection of suppliers. Wilhelm et al. (2016) explore how well the first-tier suppliers engage in their primary and secondary agency role depending on information asymmetries between the focal firm and the tier one and tier two suppliers, and the incentives for the first-tier to fulfill their double agency role. Information transparency and incentive alignment are both suggested to have a positive effect on the commitment of the double agency role of the tier one supplier.

Wilhelm et al. (2016) conclude that the buying firm needs to be aware of the double agency role of the first-tier supplier and realize that it does require additional capabilities. The buying firm should thereby influence the suppliers' abilities and motivations to engage in their double agency role through investments (Wilhelm et al., 2016). Further, Wilhelm et al. (2016) emphasize that their findings show that when buying firms only use their position of power to improve sustainability, the effects are likely limited. The authors call for joint action by lead firms together with their first-tier suppliers as well as NGOs to create a powerful coalition that can establish common sustainability standards to drive sustainability in their supply chains. A common sustainability standard makes it easier for suppliers to comply as they do not have to deal with many diverging standards by different downstream firms (Wilhelm et al., 2016).

Wu and Pagell (2011) investigate how bounded rationality and uncertainty affect decision-making in sustainable supply chain management. Although their study mainly focuses on environmental issues, they argue that their findings might be applicable to social sustainability as well. They find the positive relationship between firms' financial performance and environmental action found by some scholars as being over-simplistic. They argue that the positive relationship might exist for certain actions, such as reducing energy use or scrap, which they refer to as "low hanging fruit". However, the relationship becomes more unclear once firms look at fundamental issues like supply chain design since environmental actions in this area will require significant investments, which incur short-term costs, while the benefits will likely not materialize until a long period of time has passed. Hence, Wu and Pagell (2011) argue that if firms are to transform their supply chains to become more sustainable, they must address complexities related to, for instance, multiple actors in the supply chain and the interconnectedness between supply chains and ecological systems. They add that organizations often have insufficient information about the environmental issues in their supply chains and how different issues interact. Together, this means that firms must make decisions within sustainable supply chain management based on information containing a lot of uncertainty which they can only process with limited ability due to bounded rationality (Wu & Pagell, 2011).

Wu and Pagell (2011) found that firms who have been successful in sustainable supply chain management adopted operating principles and technical standards to deal with decision-making under uncertainty in this area. They explain that operating principles do not define what specific actions should be taken but rather formulates the firm's environmental value and goals and thereby acts as an overarching guide to all decisions. Technical standards, on the other hand, do define what specific actions should be taken in a given area. A common technical standard is supplier certification where firms only purchase from suppliers who meet their code of conduct. Wu and Pagell (2011) explain that firms may use multiple technical standards, but can only have one operating principle. The authors found that firms were able to create economically and environmentally viable supply chains over time through a sequence of inter-related decisions guided by their operating principle and technical standards.

4.5 CONCLUDING REMARKS

This section concludes the literature review by contrasting the main theories from the chapter. Williamson (1988) explains that agency theory and transaction cost theory have both similarities and differences but that they can be seen mainly as complementary perspectives of economic organization. The theories share similar assumptions of human behavior, such as opportunism although agency theory rather refers to moral hazard or agency costs than explicitly mentioning opportunism. Williamson (1988) furthermore describes that both theories are concerned with handling incomplete contracts, but agency theory primarily advocates doing this through incentive alignment while transaction cost theory instead focuses on finding suitable governance structures. The main difference between the theories, according to Williamson (1988), is the basic unit of analysis, which in transaction cost theory is the transaction while in agency theory it is the individual agent.

Fayezi et al. (2012) suggest that the complementary features of agency theory and transaction cost theory can be utilized within supply chain management. The authors explain that transaction cost theory aims at solving trade-offs, such as make or buy decisions, by translating these trade-offs into costs. Transaction cost theory, for example, considers the hidden costs of building relationships between a buyer and a seller, such as time spent developing the relationship and having a lawyer drafting contracts. However, this implies that the elements of the trade-offs can be quantified, but many aspects of supply chain relationships are intangible and can therefore not be quantified. Fayezi et al. (2012) argue that agency theory is able to deal with the intangibility of supply chain relationships as it can provide explanations to some of the more complex aspects of the relationships, such as social, political and behavioral dynamics. Agency theory can thus be used to explain the causes of abnormal behavior in supply chain relationships related to, for instance, self-interest, risk aversion, lack of trust and goal conflicts. Hence, transaction cost theory can be complemented by agency theory to understand some of the more complicated transaction cost dilemmas in supply chains.

For the purpose of this thesis, agency theory is acknowledged as the main theoretical lens since understanding and handling the complex behavior of actors in the supply chain of cobalt is highly important for the study. Transaction cost theory is rather used as a secondary theory to assess the trade-offs of implementing certain strategies. Both theories, however, have proved to be useful when analyzing sustainable supply chain management. To fully understand the complexity of the supply chain of cobalt, a multi-tier perspective is needed, as emphasized by Rowley (1997). Multi-tier supply chain management is therefore regarded as a third important theoretical lens for the study. Figure 4.1 illustrates the function of the different theories for the purpose of the thesis.

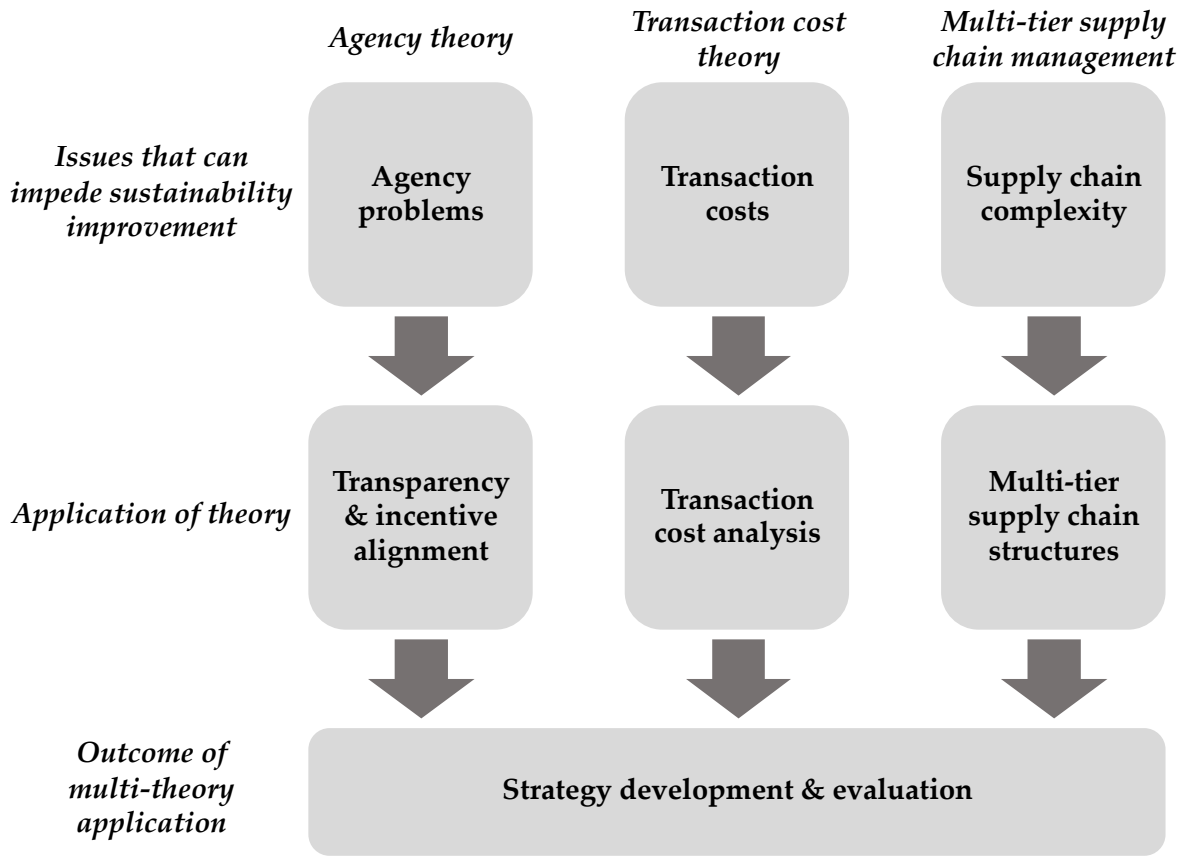

Figure 4.1: Framework for issues that the different theoretical lenses aim to address and how all the theoretical lenses tie into developing and evaluating strategies for the thesis.

5 RESULTS & ANALYSIS

This chapter presents the results of the study in two parts. The first part presents identified agency problems and their connection to social sustainability. The second part presents strategies for socially sustainable sourcing of cobalt, which are analyzed based on how well they address the agency problems and their effect on social sustainability.

5.1 AGENCY PROBLEMS AND SOCIAL SUSTAINABILITY

This section describes the agency problems that are present in the supply chain of cobalt, as well as their connection to social sustainability. As described in the literature review, agency problems arise due to asymmetric information and asymmetric incentives. Another important aspect to highlight, which was also described in the literature review, is that the sequential execution of activities in supply chains means that actors in the supply chain are both agents and principals depending on which transaction is studied. Hence, it not possible to say who the agents and who the principals are in the supply chain as it depends on the focus of the analysis. However, automotive manufacturers can be assumed to always be principals as they are located far downstream in the supply chain. The asymmetries are summarized in Table 5.1. Sources for this section mainly consist of data from interviews 1, A and B, workshop 3, and various secondary sources which will be highlighted throughout the section. However, the issues described in this section were not mentioned explicitly as asymmetries in the empirical data, but rather as general problems associated with cobalt. Hence, the asymmetries are derived from analyzing the empirical data through the lens of agency theory.

Actors	*Asymmetries*	
	Information	**Incentive**
ASM		No loyalty towards specific mine site
LSM		No commercial agreement with ASM
Buying center	Risk of false labeling	Pricing opportunism
Smelter	Control point, potential lack of corporate transparency	Inadequate due diligence
Battery Manufacturers	Not fully transparent towards automotive manufacturers	
Automotive manufacturers		Uncertain cost sharing
Non-actor specific	Supply chain complexity, increasing number of actors	

Table 5.1: Asymmetries in the cobalt supply chain by actor.

In order for automotive manufacturers to source cobalt ethically, they must be able to retrieve information on which actors in the supply chain are causing social issues and whether they indirectly sources cobalt produced by these actors. To understand why it is difficult to retrieve this information, it is important to consider what information asymmetries exist in the supply chain. Information asymmetries in the supply chain can mainly be attributed to two underlying issues, the complexity of the supply chain and actors who purposely decrease supply chain transparency. Complexity in the form of the large size of the supply chain creates information asymmetries as it becomes increasingly difficult for a firm to retrieve information with each additional step away from the firm in the supply chain. In other words, the focal firm might be able to retrieve information from its first-tier supplier, but retrieving information from lower-tier suppliers is more challenging as the focal firm is not directly in contact with them. Added to this is the fact that there are multiple suppliers at each tier, meaning that the number of sub-suppliers that the focal firm needs to retrieve information from increases exceedingly with each step, and it might be uncertain which of these sub-suppliers the focal firm indirectly source material from. Also, the number of actors in the supply chain, especially in the downstream, is expected to increase as demand for lithium-ion batteries increase. These new actors are likely to be small in size and might, therefore, lack proper processes to ensure social sustainability (Mitchell et al., 2016).

In the case of Alpha, information is only retrieved directly from the first-tier supplier, company X, in the cobalt supply chain. Alpha must, therefore, rely on the information they receive from them regarding the sustainability of the sourced cobalt. Company X does, however, disclose which smelters they source material from but not what material they source from which smelter, which creates uncertainty for Alpha as the smelters do not only produce cobalt. The fact that company X supplies material to many different customers also creates uncertainty for Alpha in terms of what cobalt they receive. Hence, there is an information asymmetry between Alpha and company X, where company X possess more information in relation to Alpha.

Actors purposely decreasing transparency is mainly an issue in the upstream of the supply chain where actors might conceal the origin of cobalt as it will be advantageous for them to do so. Buying centers are for instance highly incentivized to falsely label cobalt that they sourced from informal ASM as having a different origin since downstream actors might be hesitant to purchase cobalt originating from informal ASM. Also, since cobalt from informal ASM tends to be cheaper than other cobalt, buying centers can earn higher profits by selling this kind of cobalt. The root cause of why actors create asymmetric information in the supply chain through their way of behaving can be seen as incentives being asymmetric, meaning that some upstream actors have incentives to decrease transparency which stands in conflict with downstream firms who want to increase transparency.

An important aspect to consider in order to decrease information asymmetries is the pivotal role smelters play. The OECD (2019) describes that smelters is the control point in the supply chain of cobalt since the smelter level is the part of the supply chain where the smallest number of actors handle the largest amount of input. This implies that there is a risk of chain of custody information being lost at the smelter level, according to the OECD (2019), making it impossible to trace the cobalt to its source. At the same time, relatively few smelters have made efforts to track the cobalt beyond buying centers.

Incentive asymmetries are important to consider to understand why there are social problems in the cobalt supply chain. Hence, through understanding why some actors in the supply chain are incentivized to act in ways that creates or increases social issues, the root causes of the problems can be addressed. Downstream companies have largely aligned incentives with regards to increasing the social sustainability of cobalt but there are uncertainties in terms of whether they are equally committed to make financial investments to increase sustainability. In other words, most downstream actors appear to be willing to make some efforts to resolve the social issues in the cobalt supply chain, but it is unclear how costly they are willing to accept these efforts to be.

Some smelters have been accused of having inadequate due diligence practices to mitigate the social issues in the cobalt supply chain. For example, Amnesty International (2016) accused Huayou Cobalt, the largest smelter, of not following the OECD guidelines on mineral supply chain due diligence and therefore risk sourcing cobalt from mines with child labor and poor working conditions. These accusations indicate misalignment of incentives between smelters and downstream companies to source ethical cobalt. However, primary data for this study suggests that the negative publicity received by the fine refiners for their due diligence malpractice has made them eager to make improvements in this area. This indicates that the incentives of the

smelters have become more aligned with those of downstream companies, although there is uncertainty to what extent these incentives can be regarded as fully aligned.

The fact that the majority of smelters are Chinese also raises concerns in terms of both incentive and information asymmetries. Chinese fine refiners sometimes lack corporate transparency, which creates information asymmetries, and have inadequate sustainability practices. However, improvements are being made in these areas by the government, for instance with the launch of the Chinese Due Diligence Guidelines for Responsible Minerals Supply Chains in 2015 (Mitchell et al., 2016).

Incentive asymmetries are most evident far upstream in the supply chain where actors often lack strong enough incentives to mitigate social issues. Artisanal miners, for instance, are largely incentivized to sell the cobalt they have mined for the best possible price, which they can do since they work as individual subcontractors and can thereby choose to relocate to a mine site where they can get paid better, according to the OECD (2019). There have also been incidents where miners have smuggled material from formalized artisanal mines to sell directly at buying centers. This disloyalty towards mining sites is understandable considering these miners' poor livelihoods, but it does pose problems from a responsible sourcing perspective especially since it curbs the formalization of artisanal mining.

Incentive issues are also evident for LSM, particularly in its interaction with ASM as described by the OECD (2019). LSM often relies on being able to purchase cobalt from ASM in order to be flexible and fulfill commercial requirements. However, there is generally no formal commercial agreement between the LSM and ASM actors, which is problematic as ASM sites are then classified as informal. It is uncertain whether LSM actors have incentives to make these investments but the small number of formal ASM sites indicates that such incentives are not very strong. Hence, there is misalignment between LSM and downstream companies' incentives to source cobalt responsibly due to the lack of commercial agreement between LSM and ASM. There are also other examples of problematic behavior by LSM, including corruption and bribery.

The buying centers are problematic from an incentive alignment perspective due to their strong incentives to obtain low prices when they purchase material. This is evident as fraud is frequently reported at the buying centers since miners suspect that the buying centers manipulate the instruments used to sample and weigh the material in order to get a lower price (OECD, 2019). The issue related to buying centers could, however, be resolved through formalization of ASM since the buying procedure is then more structured as the buying center is then integrated into the ASM site.

5.2 STRATEGIES FOR SOCIALLY SUSTAINABLE SOURCING

This section will present possible strategies that an automotive company can adopt to improve social sustainability in its supply chain of cobalt. As described in section 2.4, the strategies were developed by first making hypotheses on potential strategies based on literature and secondary data which was then used as a basis for interview questions. Thus, the final strategies were derived after the interviews had been conducted. However, due to difficulties in collecting interview data, the strategies are based on secondary data to a larger extent than originally planned. All strategies are presented in Table 5.2, including sources used to develop them. This section will also present analyzes of the strategies based on how they improve sustainability and how they address the agency problems. Additionally, analyzes of the strategies based on transaction cost theory are presented. The section is divided into five subsections where the first two subsections, indirect and directs strategies, describe strategies with two different strategic approaches with different levels of interaction with upstream firms. The third subsection outline two approaches automotive manufacturers can adopt towards ASM, engagement and disengagement. The fourth subsection describes strategies for increased supply chain transparency. The fifth and last subsection, horizontal leverage, describes the effects of joint initiatives between downstream companies. The terms used to describe the strategies are partially based on literature and partially developed by the researchers themselves.

Strategy	Tools	Sources
Indirect		
Delegation to first-tier supplier	Code of conduct, audit	Wilhelm et al. (2016), Tachizawa and Wong (2014), interview 1
Directed buy	Approved smelter list	Tachizawa and Wong (2014), Wu and Pagell (2011), workshop 1, interview 6
Direct		
Capacity building	Training, investments	Anisul Huq et al. (2014), Wilhelm et al. (2016), Tachizawa and Wong (2014), Johansson de Silva et al. (2019), interview 2 & A
Direct procurement	Contract with mine or smelter	Mena et al. (2013), interview 2, 3, 8 & B
Incentive schemes	Reward, punishment, risk sharing, volume/price increase	Anisul Huq et al. (2014), Jiang (2009), Wilhelm et al. (2016), Johansson de Silva et al. (2019)
ASM approach		
ASM engagement		Amnesty International (2016), OECD (2019), interview 6 & B
ASM disengagement		Amnesty International (2016), OECD (2019), interview 6 & B
Transparency		
Supply chain mapping	Chain of custody	OECD (2013), interview A, workshop 2
Traceability	Mass balance, "bag and tag", anomaly detection	OECD (2013), interview A, workshop 2
Complementary		
Horizontal leverage	Industry initiatives, joint due diligence standards	Wilhelm et al. (2016), Tachizawa and Wong (2014), OECD (2019), interview 6 & B, workshop 3

Table 5.2: Strategies for socially sustainable sourcing.

5.2.1 INDIRECT STRATEGIES

With indirect strategies, the focal firm is only in contact with its first-tier suppliers to support sustainability in the supply chain, as shown in Figure 5.1. The focal firm can still aim to improve sustainability throughout the supply chain, but only do so through their first-tier supplier rather than directly cooperating with companies further upstream. This section presents two indirect strategies: delegation to first-tier supplier and directed buy.

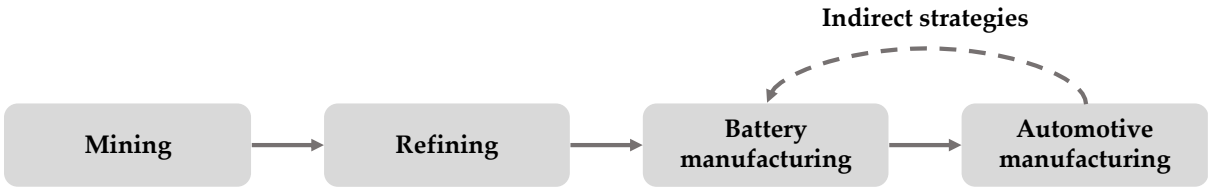

Figure 5.1: Application of indirect strategies in the supply chain.

Delegation to first-tier supplier is a strategy where companies in multi-tier supply chains put pressure on their first-tier supplier to comply with their sustainability policies, often through a supplier code of conduct. The code of conduct can be cascaded throughout the supply chain, meaning that the first-tier suppliers are responsible for the compliance of its direct suppliers (the second-tier suppliers). This leaves the supplier with a lot of responsibility, as they not only have to be concerned with their own compliance but also the compliance of their suppliers. The supplier is thereby put in the position of double agency as described by Wilhelm et al. (2016). The code of conduct is commonly accompanied by audits, often by a third party, to control compliance.

The fact that incentives to increase social sustainability between automotive manufacturers and battery manufacturers are largely aligned favors delegation to the first-tier supplier. However, the strategy might still be subject to agency problems in the form of moral hazard or adverse selection. In other words, the battery manufacturer arguably has a motivation to appear to have strong incentives of wanting to improve social sustainability in the supply chain since they can then increase their sales. Also, automotive manufacturers are likely to have a higher exposure to media scandals related to social issues compared to the battery manufacturer since the automotive manufacturer sell their products directly to end customer (Hartmann & Moeller, 2014). The battery manufacturer can, therefore, increase its risk exposure as they do not bear the full costs of these risks.

Moral hazard or adverse selection might also be a result of difficulty in measuring outcome associated with the delegation strategy, in terms of how well the first-tier supplier is performing from a sustainability perspective. This has to do with the information asymmetry that arise as the delegation implies that only the first-tier supplier is given information on activities further upstream in the supply chain. Apart from making it difficult for the focal firm to measure the first-tier suppliers' outcome, the information asymmetry also enables the first-tier supplier to act opportunistically, should they want to, without the focal firm knowing about it. Measures to increase transparency is therefore important for the delegation strategy to succeed. These measures might, however, be difficult to implement in some cases as exemplified by interviewee

1 and 8, who mentioned that company X is unwilling increase transparency by, for instance, disclosing second-tier suppliers to Alpha.

The difficulty in measuring outcome could, however, also be seen as a consequence of the first-tier supplier being several tiers away from the actual social issues in the supply chain related to, for instance, child labor and poor working environments. Finding connections between actions taken by the supplier and social issues is thus more difficult for the first-tier supplier compared to a supplier further upstream.

Automotive manufacturers should support their first-tier suppliers' double agency role, as emphasized by Wilhelm (2016), by stimulating the suppliers' abilities and motivation, and thereby develop their capabilities. Transparency of information also has a positive effect on the commitment of the double agency role as described by Wilhelm (2016), which reinforces that transparency is important for the success of the delegation strategy.

The fact that Alpha only accounts for a small portion of the battery supplier's total sales create a power asymmetry between the two in this case. Alpha is therefore subjected to an opportunism risk as the battery supplier might exploit this bargaining power as described by Clemons (1993). To what extent other automotive manufacturers are subjected to this risk is unknown. However, in line with Williamson's (1981) theory of incomplete contracting, the opportunism risk, derived both from the power asymmetry and asymmetric information, means that it is not possible to construct a code of conduct that completely eliminates the risk that the battery supplier is not compliant.

With **directed buy**, focal firms direct which sub-suppliers the first-tier suppliers are allowed to source from. This aims to ensure that first-tier suppliers source the material from compliant sub-suppliers. In the supply chain of cobalt, some of the OEMs direct their battery manufacturer to source from specific smelters. Alpha has for instance launched a program directed at suppliers who source conflict minerals (tin, tantalum, tungsten and gold) and cobalt. To be compliant with the program, the suppliers must prove that they only source these materials from smelters listed as conformant by the Responsible Minerals Initiative (RMI), and if not, show that they have taken action for improvements. However, only four smelters of cobalt are listed as conformant, of which none are in China (RMI, n.d.).

Directed buy has the potential to reduce agency problems by lowering information asymmetries in the supply chain. As the focal firm directs which sub-suppliers the first-tier supplier can source material from, the number of possible sub-suppliers decreases. This reduces the complexity of the supply chain which, as described in section 5.1, is a cause of information asymmetry. Directed buy has therefore the potential to address some of the issues of moral hazard and adverse selection associated with the delegation strategy as the buying firm takes on more responsibility by assisting the first-tier supplier in supplier selection. However, much responsibility is still delegated as the smelter or mine, which the buying firm directs the first-tier supplier to buy from, is responsible to source sustainably. The first-tier supplier also bears the responsibility to follow the direction of what sub-supplier to source from. This may prove to be troublesome, if the focal firm directs to specific smelters or mines, as the battery manufacturer does not source directly

from either of them. In order to confirm that the first-tier supplier follows the directions of the focal firm, the directed buy strategy needs to be combined with auditing as well as further measures to improve the supply chain transparency.

The directed buy strategy has a low asset specificity as it is easy to redirect if a sub-supplier is non-compliant, which is positive since transaction costs is thereby reduced. However, interviewee 6 points out that a strategy where non-compliant sub-suppliers are avoided is not recommended, which also is emphasized by Amnesty International (2016). Instead, the buying firm should promote improvements of social sustainability rather than delist non-compliant sub-suppliers, which is in line with Anisul Huq et al. (2014) who recommends collaboration with the supplier rather than only auditing. The few number of smelters listed as conformant by RMI further support the argument that clear steps towards improvement are more important than already being compliant. The buying firm is otherwise limited to a very few number of smelters which limits the supply available and the buying firm's bargaining power.

The power asymmetry in the relationship between Alpha and its battery supplier is also an issue with the directed buy strategy. Interviewee 1 report that because of the power asymmetry, the battery supplier is perceived to be unwilling to be directed towards certain suppliers as they want to remain in control over its supply chain, which hinders a successful directed buy strategy.

5.2.2 DIRECT STRATEGIES

Direct strategies imply that focal firms do not only work with their first-tier supplier but also directly with suppliers further upstream to improve sustainability in the supply chain, as shown in Figure 5.2. This section presents three direct strategies: direct procurement, capacity building and incentive schemes, which all require direct contact with upstream firms. Direct strategies presented in this section focus on collaboration at two points in the supply chain of cobalt: smelters and mines. The mines are chosen as a possible point of contact since the root problems in the supply chain of cobalt is connected to mining operations in the DRC. The smelters are identified as a beneficial point of contact because of their pivotal role in the supply chain related to the fact that they are few in numbers, have the possibility to control the origins of the cobalt and handles it before it physically changes form.

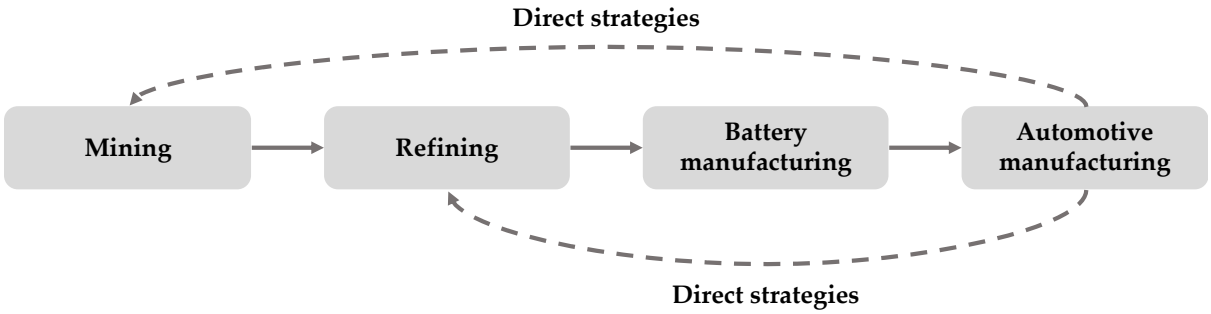

Figure 5.2: Application of direct strategies in the supply chain.

With **direct procurement**, the focal firm directly purchases the cobalt from mines or refined material from smelters and provides it to its supplier. The strategy involves a long-term

partnership with either smelters or mining companies of whom the material is purchased, rather than making a one-time purchase. The direct procurement strategy is therefore different from directed buy in terms of the ownership of the material as well as the direct contact with the upstream firm. The strategy entails that the focal firm gains the power to control where the cobalt is mined, or at least which smelter it comes from, and thereby a larger possibility to gain a high level of transparency in the supply chain.

Because of these possibilities to gain supply chain transparency, the direct procurement strategy has the potential to reduce the information asymmetries. However, the strategy requires agreements with intermediate suppliers as both the smelters and mines are not direct suppliers of neither battery manufacturers nor automotive manufacturers, as explained by interviewee 3, which implies higher transaction costs as both time and money are spent to arrange these agreements.

The choice of sub-supplier to buy the material from is an important factor that affects how sustainable the focal firm's supply chain will be as the sub-supplier is still the actor who is responsible for mining the cobalt or, at least, procure it from the mines. To ensure ethically sourced cobalt the focal firm, therefore, needs to be meticulous when choosing a sub-supplier of whom to buy the material from, as information asymmetries probably exist, since miners and smelters likely have more information regarding under what conditions the cobalt is sourced than automotive manufacturers. Therefore, there is a risk of adverse selection, as the sub-supplier might be incentivized to exploit the information asymmetry. Due diligence is, therefore, an important measure to take before entering a partnership. Auditing the sub-supplier, once a deal has been made, is also important to ensure that they keep a high level of social sustainability, or at least, takes clear steps for improvements.

Having a purchasing contract with sub-suppliers can have a positive impact on the buying firm's ability to affect the sustainability of the sub-supplier as the contract can include clauses that regulate this. This is in line with Norrman (2008) who argues that well-defined contracts support long-term trusting relationships. Having a contract with a sub-supplier, however, implies higher transaction costs, as it is likely costly to review and negotiate with an upstream actor. It is, therefore, preferable from a transaction cost standpoint to only enter into a direct procurement partnership with a single sub-supplier rather than many. A smelter or LSM actor would thus be an appropriate sub-supplier to enter into such a partnership with as they handle large quantities of material. ASM would be a less appropriate actor to enter into a direct procurement partnership with as they handle smaller quantities of material, meaning that partnerships with multiple ASM actors might be required which would imply higher transaction costs. The direct procurement strategy is also associated with high transaction costs as it is highly asset-specific since specific investments are needed before entering into a partnership with a supplier is needed, such as due diligence, which cannot be easily re-deployed with a different supplier.

The problem with the power asymmetry between Alpha and its battery manufacturer described under indirect strategies is also present with the directed procurement strategy. Interviewee 1 and 8 perceive that the battery suppliers may be unwilling to let their customers source their material for them, which might impede the implementation of the direct procurement strategy.

Generally, the direct procurement strategy can be considered a hierarchical strategy as the focal firm themselves are procuring the raw material from the sub-suppliers and hands it over to its suppliers rather than relying on the market. However, elements of market governance can also exist depending on the level of collaboration with the supplier. With a market governance style, the supplier only has to pass the initial audit compared to a hierarchical governance style where the buyer participates in the supplier's development (Anisul Huq et al., 2014). Hence, the approach to choose a supplier to enter into a direct procurement partnership can be either market-oriented or hierarchy-oriented, even though the strategy itself entails hierarchical governance. Hierarchical governance is recommended by Anisul Huq (2014) when implementing social sustainability in developing countries which implies that choosing suppliers with a market governance style should be avoided when the direct procurement strategy is used.

Incentive schemes include various measures that focal firms can adopt to incentivize actors in the supply chain to improve its operations to become more sustainable. These incentives can be included in a contract with the supplier and therefore require a direct relationship between the focal firm and the supplier. The following have been identified as potential measures to include in incentive schemes: rewards, punishments, volume or price increase and risk sharing. Rewards mean that the supplier receives compensation if it demonstrates responsible behavior. The compensation could be purely monetary but other alternatives are also possible, for instance by rewarding the supplier with larger orders. Wilhelm et al. (2016) describe that compensation like this can be based on whether the supplier performs above average in sustainable development according to a set of predefined key performance indicators (KPIs). For a mine, the KPIs could be based on the absence of children working at the mine site or low numbers of accidents. Punishments would work similarly to rewards but instead of the supplier receiving compensation for good behavior, they get a fine for poor sustainable behavior.

Anisul Huq et al. (2014) describe that paying higher prices to suppliers or giving them larger orders are enablers of social sustainability. The idea is that the suppliers will then be incentivized to make improvements and thereby become more sustainable as they would have more resources to do so through the price increases or larger orders. The main difference between this measure and the aforementioned rewards is that price and order increases could be awarded without assessing the supplier's past performance. Risk sharing would be another way to incentivize the supplier of committing to improved social sustainability since the supplier would then be protected against external factors that could deteriorate the value of sustainable investments. More specifically, risk sharing would imply that the focal firm commits to compensating the supplier in case an external uncontrollable event would occur. For instance, the focal firm could protect an artisanal mine from the risk of decreased cobalt prices, since this can inhibit formalization of artisanal mining, by giving the mine a compensation corresponding to at least part of the price decrease.

Incentive schemes aim to overcome agency problems by aligning incentives, which is something many authors in the agency theory literature emphasize, such as Eisenhardt (1989), Ketchen and Hult (2007), Halldorsson et al. (2007) and Narayanan and Raman (2004). Including incentive schemes in a contract with a supplier makes the contract outcome-oriented rather than behavior-oriented, especially if the reward or punishment measures are used. This means that automotive

manufacturers do not need to have exact information regarding the actual behavior of the supplier since the strategy instead aims at aligning incentives between them and the supplier. The reliance on supply chain transparency thus becomes lower if incentive schemes are adopted. This is however only true for the steps in the supply chain that lies further upstream of the supplier where incentive schemes are adopted.

The issue that external factors might affect the outcome, which Eisenhardt (1989) describes, should be considered before adopting incentive schemes. A mine might, for instance, perform poorly in terms of the number of accidents, not because they have not taken measures to mitigate risks of accidents but because of natural disasters or other uncontrollable events. It might be possible to prevent certain external factors from affecting incentive schemes, but presumably not all due to the incomplete nature of contracts. Rewards and punishments ought to be most exposed to the risk of external factors as the outcome is continuously measured against a predefined KPI. There is also a risk that suppliers will act opportunistically through misrepresenting their outcome in their favor when rewards or punishment are employed so that they can receive larger rewards or fewer punishments. Price or order increases might be more appropriate measures to include in incentive schemes since they are not so reliant upon measuring the outcome, which reduces the negative effects related to the influence of external factors and misrepresentation of the outcome. Price and order increases are, however, still subject to opportunistic behavior as it is assumed that the supplier will use the additional resources received from the price or order increase to improve their sustainability, which might not be the case. The problem is then, similar to how Williamson (1981) describes the problem of opportunism, that automotive manufacturers cannot know ex-ante if the supplier will use the additional resource to improve sustainability or not. Auditing, both initially and continuously, could mitigate this risk but not remove it completely due to potential mock compliance.

In terms of where incentive schemes should be implemented, it could be argued that it would have the most impact on the smelter level since this is an aggregation point in the supply chain. Thus, by aligning incentives with smelters, it might be possible to mitigate a lot of the social issues that exist in the upstream supply chain of cobalt as the smelters are in control of a lot of material in this part of the supply chain. The small number of smelters also means that it would be transaction cost-efficient to implement incentive schemes towards them. The fact that incentive schemes reduce the need for supply chain transparency beyond the supplier also motivates implementing incentive schemes here as opposed to doing it even further upstream, since this becomes less of an advantage the further upstream it is implemented. On the other hand, as was described in section 5.1, incentive misalignment exists mostly even further upstream in the supply chain, beyond smelters, and incentive schemes might, therefore, have more impact if it is implemented there. Thus, it could be argued that the issues of social sustainability related to smelters cannot be attributed to them not being incentivized to act sustainably but rather that they do not have full control and transparency over the far upstream part of the supply chain, where the social issues exist. If this is the case, implementing incentive schemes would not have that much of an effect, if any, in terms of resolving the social issues in the supply chain.

Incentive schemes could be implemented towards either ASM or LSM. As for ASM, such measures should strive to promote the formalization of ASM, in which case ASM workers' poor

living conditions and the fact that they can easily change to another mine site should be considered. Aligning incentives through penalties might, therefore, have a negative effect on the formalization of ASM as the penalties could affect the ASM workers' pay which can lead them to switch to another site. Rewards could be a better option in this situation, but it could also be that ASM sites have scarce resources to begin with and might therefore be restricted, to some extent, from performing well from a sustainability perspective. With this reasoning, incentive alignment through volume or price increases would be more suitable, at least in an initial phase before sustainable operations are in place at the ASM site. Risk sharing could also be an appropriate incentive alignment tool for ASM since cobalt price decrease, in particular, has proved to inhibit the formalization of ASM. Regardless of which incentive scheme implemented towards ASM, it should be done in a collaborative manner where the conditions of the specific ASM site are considered, similar to what is recommended by Anisul Huq et al. (2014). Directing incentive schemes toward informal ASM would not be suitable as the informality implies difficulties in, for instance, having contracts with these actors, which the strategy requires.

Incentive schemes could also be implemented in a contract with an LSM actor, which could aim at both promoting sustainable operations at the LSM site but also, and probably most importantly, in its interaction with ASM. The LSM actor could, for instance, be incentivized to always have a commercial agreement with the ASM actor it sources cobalt from as this would encourage the formalization of ASM. The motivation for implementing incentive schemes towards LSM rather than ASM is that LSM, similar to smelters, handles more material than ASM. It could thus be argued that the positive effects on social sustainability would be larger if the incentives of one LSM actor is aligned as opposed to one ASM actor. On the other hand, the social issues are mostly present in ASM, and only addressing them indirectly through incentive alignment with LSM would arguably not fully resolve them. To what extent it is possible to improve social sustainability through incentive schemes towards LSM will likely depend on the specific LSM actor. The level of interaction between LSM and ASM, both in terms of the number of ASM actors that the LSM actor interacts with and how close the interaction is, could, for instance, be an important metric to consider before implementing incentive schemes. A higher level of interaction would motivate adopting incentive schemes towards LSM as the LSM actor would then be able to influence how sustainable ASM is to a larger extent.

Capacity building focuses on developing the capabilities of the suppliers by training the suppliers or directing other types of investments towards them, rather than choosing to source from suppliers that are already compliant. Automotive manufacturers could, for instance, engage in capacity building activities with smelters, LSM or ASM, where the most appropriate activity will likely differ depending on the actor. Capacity building can, for instance, be conducted with smelters and LSM to help them increase their supply chain transparency as well as their ability to source and promote ethically mined cobalt. Capacity building with ASM might involve formalization of ASM sites which often includes investments and training to ensure that proper safety regulations are followed and that no underage or non-trusted workers are let into the site. Measures to increase productivity and decrease corruption have also been made at ASM sites.

If the downstream firm engaging in capacity building with upstream actors wants to ensure that the material from these actors ends up in their products, a high level of control of the supply

chain is needed. However, investments can also be made even if the focal firm does not have control or high transparency in their supply chain but still intends to improve the conditions in the DRC, regardless of whether the mines where investments are made exists in the focal firm's supply chain. In the latter scenario, the capacity building rather functions as a PR-strategy where the focal firm demonstrates good intentions to customers or other external stakeholders.

The major advantage of the capacity building strategy is that the relationship between the focal firm and suppliers become less principal-agent like in character as the focal firm them self takes more control over what actions are being done to improve the sustainability by delegating fewer tasks. As highlighted above, automotive manufacturers can, for instance, assist an ASM site in ensuring that proper safety procedures are adopted instead of delegating this activity completely. However, removing the principal-agent relationship altogether would not be possible since the delegation of activities lies in the nature of the buyer-supplier relationship. This means that agency problems can be avoided to some extent through capacity building, but not entirely.

Capacity building can relieve some of the pressure of the first-tier supplier by directly working with sub-suppliers for improvements. However, it is important to not neglect the first-tier supplier when managing sub-supplier as Grimm et al. (2016) point out. The first-tier supplier must be involved in a way so that it does not get the impression of being ignored, and also ensures that it is still aware of its remaining responsibilities.

Capacity building is characterized by high asset specificity as the investments in one sub-supplier rarely can be utilized at another sub-supplier. This leads to a reluctance of the buyer to switch suppliers, as this would lead to additional costs that could be exploited by the supplier, through for instance raising prices, and thereby creating a higher opportunism risk as described by Clemons et al. (1993). The capacity building strategy is, thereby, characterized by high transaction costs and would preferably be combined with hierarchical governance, as recommended by Grover and Malhotra (2003).

The motivations for where to implement capacity building share similarities for those described for incentive schemes. For instance, the fact that smelters are few and handle large amounts of material means that directing capacity building towards only one or a few smelters could be sufficient to increase social sustainability in the supply chain, given that the smelter in question has good control over its sourcing activities. The idea is then that the improved sustainability practices implemented at the smelters could propagate to the smelter's suppliers and thus improve social sustainability in the upstream overall. Working with only a few smelters is also advantageous from a transaction cost standpoint. However, the social sustainability problems, as well as the agency problems, are most prominent further upstream in the supply chain, beyond smelters. Implementing capacity building towards actors beyond the smelters should, therefore, not be neglected, depending on the situation. When implementing the capacity building strategies at the mine level, the focal firm can ensure that progress is being made to improve the problematic conditions in the DRC, rather than relying on a supplier further downstream, such as smelters, for improvements.

When capacity building is directed towards ASM, in the form of ASM formalization, it could be appropriate to include measures that increase the miners' productivity, in addition to measures that improve social sustainability. The increase in productivity could then offset the potential price increase of the cobalt from these mines, which is a result of increased overhead costs related to, for instance, improved safety practices. The productivity increase could also incentivize the miners to keep working at the formalized site, thereby making the improved social sustainability durable over time.

5.2.3 ASM APPROACH

Firms pursue mainly two different approaches to ASM, engagement and disengagement. Engagement entails downstream firms accepting that the issues related to ASM exist in their supply chain and potentially also taking steps to improve its conditions, in other words formalizing it. The other approach is to not source any ASM material at all and thus work to ensure that the company is not connected to the issues of ASM mining in the DRC. Strategies to do so include direct procurement, where OEMs strike deals with for instance LSM actors who can ensure that the cobalt is not sourced from ASM. BMW, for instance, negotiated a deal with the mining company Glencore who will supply BMW with cobalt from mines in Australia and Morocco (Clowes, 2019). Companies further upstream has also taken actions to remove ASM from their supply chains. The Belgian refiner Umicore has, for instance, adopted a strict policy of not sourcing any ASM material (Umicore, 2019). However, having a deal with an LSM actor does not necessarily ensure that no ASM material is sourced as explained by OECD (2019):

> Simply because a company mines or processes LSM material does not necessarily mean that they have a high degree of control or transparency over their supply chain, or that they do not also source ASM material. (p. 21)

While companies who pursue the disengagement strategy aim to disconnect themselves from the issues related to ASM, the issues themselves prevail. The problems can, in fact, even be worsened when companies actively try to remove ASM from their supply chains as many households in the DRC are dependent on the income from ASM (Faber et al., 2017; OECD, 2019). Lower levels of income can, for instance, increase the prevalence of child labor. There are also indications of impaired profitability when ASM is avoided. Umicore claims that the inflow of cobalt from ASM drags the prices down which enables their competitors who source from ASM to sell products at a lower price, affecting Umicore's profitability negatively (Umicore, 2019).

As demand for cobalt is rising, it is unlikely that the ASM disengagement will be possible on a wider scale. In other words, a single firm might be able to avoid sourcing any ASM material, but ASM is likely to be an important source of cobalt for the market as a whole since LSM actors sources cobalt from ASM to fill gaps between supply and demand (OECD, 2019). These gaps will arguably become more prevalent in the future as data suggests that supply might not be able to scale up fast enough to meet the demand increase, which was described in section 3.2. If ASM disengagement is then adopted by firms on a wider scale, LSM actors will be forced to source ASM material without disclosing it to downstream firms.

ASM disengagement is also problematic as formalized ASM is then not acknowledged, which can lead to a situation where formalized ASM is pushed out of the market. This can be understood through Akerlof's (1978) theory on information asymmetry which says that if high-quality products are not acknowledged through premium pricing, they will be pushed out of the market by low-quality products. Thus, if ASM continues to be an important source of cobalt in the future, but formalized ASM is not acknowledged, it is likely to be outcompeted by informal ASM that has lower overhead costs.

Firms who adopts an ASM engagement strategy through participating in ASM formalization projects should not only focus on immediate improvements but also ensure that the ASM sites become sustainable over time. It is, therefore, important to consider the fact that ASM workers can easily transfer between different ASM sites. The formalization project should thus be designed so that the ASM workers are incentivized to keep working on the formalized site, regardless of external conditions such as cobalt price decreases.

5.2.4 SUPPLY CHAIN TRANSPARENCY

This section describes a selection of strategies to achieve supply chain transparency which can be divided into two categories: mapping and traceability. Supply chain mapping entails identifying actors in the supply chain by investigating the chain of custody, in other words, who purchase material from who. Thus, supply chain mapping is a top-down approach where the focal firms start by identifying their first-tier cobalt suppliers, then second-tier and so on. Many OEMs have mapped their supply chain to smelter level, but Alpha has not yet completed their mapping beyond their first-tier supplier. Traceability is a more rigorous alternative to supply chain mapping where the focal firm instead aims to trace the material all the way from the mine to their products. Supply chain mapping only gives a snapshot of how the supply chain is structured and does not account for the fact that the supply chain is dynamic and changes continuously, which traceability captures to a larger extent. Traceability implies that the focal firm tries to pinpoint how the material flows in the supply chain, including how the material might be mixed at various points in the supply chain. However, traceability is hampered by the fact that the material shifts form at various points in the supply chain, for instance at smelters, which makes it harder to achieve transparency. With these difficulties in mind, two ways to achieve transparency through traceability will be described: mass balance and the "bag and tag" method.

Mass balance tracks the inputs and outputs of processing steps by retrieving data from a supplier's, for instance, a smelter's, production management system. More specifically, the mass balance method builds on identifying the amount of material that goes into a process step and then comparing the amount of expected output with the actual output. Any discrepancy between expected and actual output would indicate an unanticipated material flow. The supplier might, for instance, have sold some of the material instead of processing it. The mass balance method could also be used to check that output from one actor in the supply chain equals the input of the next actor. A larger amount of input of the next actor could indicate that cobalt from an untrusted source is introduced to the supply chain. On the other hand, it is also possible for an actor to have multiple suppliers that are all trusted actors.

With “bag and tag”, the cobalt is encapsulated and tagged with a QR-code when mined which is then scanned at every stage in the supply chain in order to track the material. When the material physically shifts shape in various refining operations, a new tag is printed that inherits the identity of the previous tag. Information on the location of the material retrieved from QR-code scans can be stored in a traditional relational database or in a blockchain database. The main advantage of using blockchain technology compared to a relational database is that it is much harder to change and distort data stored in a blockchain and it can thus be seen as a safer alternative. On the other hand, storing and retrieving information in a relational database is oftentimes more efficient compared to a blockchain database.

Even though traceability aims to detect how the material flows in the supply chain with high accuracy, it still possible to trick these techniques by mixing material from trusted sources with other material. To mitigate this risk, anomaly detection could be used where machine learning is utilized to detect deviations from typical patterns for handling material. This technology can be used in mines to detect abnormal activities which could imply that cobalt from the mine is being mixed with cobalt from an unknown source. Abnormal activities in mines could include unusually large quantities, unexpected timing of shipments from the mine, material from the mine being shipped from unusual locations or unknown persons entering the mine site (which requires facial recognition). Anomaly detection could also be used in other steps of the supply chain, for example at smelters, to identify the mixing of cobalt from trusted sources and unknown sources. The machine learning technology can then be utilized to detect, for instance, mass balance deviations, unusual durations of process steps or processing taking place at unexpected locations.

However, even using anomaly detection might not be sufficient to ensure that no unknown materials enter the supply chain in some step and ends up in EV-batteries, which ultimately has to do with the complexity of the cobalt supply chain. There are many different points in the supply chain where actors interact and where the material is aggregated. Hence, to fully track the material, all aggregation points must be identified and all possible sources that could potentially aggregate material to these points must be detected, which is likely not possible given the large number of aggregation points. Downstream firms could, on the other hand, try to create a closed-pipe supply chain by ensuring that all processing steps in the supply chain use batch production where actors do not mix material from different suppliers in one batch. Batch production would however not be possible in all processing steps as some require continuous production. It is thus not likely that full transparency can be achieved in the cobalt supply chain given the identified strategies.

The purpose of using supply chain transparency from an agency theory perspective is to overcome agency problems by removing information asymmetries. Supply chain transparency is thus a requirement for using behavior-oriented contracts. However, as it is unlikely that full transparency can be achieved, it is probably not possible to completely remove information asymmetries in the cobalt supply chain and use a pure behavior-oriented contract.

The different transparency strategies are associated with different levels of transaction costs. It is mainly the traceability methods that clearly contain elements of increased transaction costs. What

Clemons (1993) describes as coordination costs, the cost of exchanging information between parties, is clearly prevalent in both mass balance, as information has to be retrieved from the supplier's production management system, and in bag and tag, since information is then retrieved from QR-code scannings. There are also elements of asset specificity in the traceability methods since investments have to be directed towards specific suppliers. Integration towards a specific supplier's production management system and the fact that a specific supplier needs to incorporate QR-code scannings in their production process are both examples of asset specificity. Anomaly detection is also associated with asset specificity since potential anomalies will likely differ slightly between different suppliers. It is not possible to determine which of the traceability methods that will render the highest transaction costs with the collected empirical data, but traceability, in general, will most likely result in higher transaction costs than supply chain mapping. The higher transaction costs of traceability could, on the other hand, be motivated by the fact that it results in a higher level of transparency.

5.2.5 HORIZONTAL LEVERAGE

As opposed to only working with actors in its cobalt supply chain, automotive manufacturers could also deal with the sustainability issues related to cobalt by working together or with other OEMs who purchase cobalt. They could thereby create leverage towards upstream actors by seeking horizontal cooperations, which could serve as a complement to the aforementioned strategies. Wilhelm et al. (2016) recommend companies to cooperate with other lead firms and NGOs to implement joint sustainability standards as this can serve as a way to both exert power on first-tier suppliers and make it easier for suppliers to be compliant as they will only have to fulfill one joint standard, which could reduce the risk of mock compliance. OECD (2019) also recommends downstream firms to cooperate in order to create leverage towards suppliers and mentions different measures to accomplish this, including joining industry initiatives, using standardized templates for requesting due diligence information, and streamlining due diligence expectations. They also mention that cooperation between downstream firms could be a way to create leverage against smelters, which is important because of the influence smelters can have over other upstream actors to improve due diligence practices. This is both due to the fact that there are relatively few smelters and because they sometimes have exclusive buying agreements with actors in the DRC or are vertically integrated. It might be difficult for downstream actors to single-handedly create leverage over smelters, especially since they are several tiers removed from them, collaborating with other OEMs could thus be a way to increase this leverage. Horizontal leverage could also be a way for automotive manufacturers to reduce the potential power imbalance between themselves and their first-tier supplier.

The core problems in the cobalt supply chain are complex and in essence, rooted in the problematic conditions in the DRC. It could be argued that a single firm only has a negligible ability to improve these conditions. Thus, cooperation between firms might be necessary to tackle the root of the problems, both because of increased leverage but also since sharing solutions, as opposed to finding unique solutions, might be more efficient. Also, cooperation between firms often results in media exposure, horizontal leverage might, therefore, be a good strategy from a PR-perspective.

Horizontal leverage can be a way to overcome agency problems through incentive alignment as upstream actors become incentivized to increase their social sustainability if downstream actors exert leverage on them. However, Wilhelm et al. (2016) describe that buying firms should not only use their position of power to enforce sustainability on suppliers as this tends to have a limited effect on increasing sustainability in the supply chain. The same applies to horizontal leverage, meaning that the firms participating in these collaborations should not expect that their ability to exert leverage on downstream actors can be enough to resolve the social issues in the cobalt supply chain. It is thus important to highlight once again that horizontal leverage should be seen as a complement to other responsible sourcing strategies.

The extent to which OEMs are willing to collaborate with each other to increase sustainability should also be considered to determine the effectiveness of horizontal leverage. As mentioned in section 5.1, downstream companies have largely aligned incentives but it is unclear to what extent they are equally willing to put in financial resources to increase social sustainability. This uncertainty should be explored further, but it could also be argued that horizontal leverage does not require any major financial investments. OEMs that are competing directly might, for instance, be unwilling to share their sourcing strategies with each other. The effectiveness of horizontal leverage is also dependent upon how similar the collaborating OEM's cobalt supply chains are. The strategy would be more effective if the collaborating firms had more or less the same suppliers (including sub-suppliers) as they would then be able to exert more leverage on those suppliers. The complexity of the cobalt supply chain could be an indication that the probability of OEMs having exactly the same suppliers is low. This was confirmed by interviewee A who claimed that OEMs tend to have unique supply chains for cobalt in general. On the other hand, there will likely be similarities at certain points in the supply chain, especially at the smelter level since only about ten smelters handles most of the material. It could also be argued that firms can exert leverage through horizontal collaborations without having the same suppliers, although this leverage would be slightly less powerful. Lastly, it should be noted that horizontal leverage will be associated with transaction costs, mainly in the form of coordination costs, and an automotive manufacturer must consider whether the increased leverage that can be utilized through collaborating with other OEMs is worth the increased transaction costs.

6 DISCUSSION

This chapter discusses and compares the different strategies from the results with the intention to find a recommended approach that an automotive manufacturer can adopt to increase social sustainability in the supply chain of cobalt. It is, however, difficult to give a recommendation on which of the social sustainability strategies is preferred as there are a lot of uncertainties in the results. These uncertainties are due to a lack of data in certain areas, which can be seen as a consequence of the explorative nature of the study. Hence, the fact that the study set out to primarily explore possible strategies, rather than to analyze a single strategy, prevented investigating all uncertainties related to the different strategies to some extent. An approach where, for instance, specific factors affecting the implementation of a certain strategy were investigated more thoroughly would have removed certain uncertainties, but adopting this approach for all identified strategies would have been too extensive. Thus, the adopted approach allowed for a more holistic view of possible strategies but, presumably, at the expense of uncertainties related to the evaluation of the strategies. An alternative approach may have given more extensive data in certain areas, but it could, on the other hand, have failed to discover certain strategies altogether. This chapter is divided into four sections were the first section describes how the adoption of strategies implies that the automotive manufacturers must balance different risks, the second section describes how different strategies can be combined, and the third section describes how contextual factors affect the adoption of strategies. The last section includes some concluding remarks.

6.1 BALANCING RISKS IN THE ADOPTION OF STRATEGIES

As described in the literature review, agency problems can be dealt with by using either outcome-oriented or behavior-oriented contracts. The results showed that different strategies share similarities with one of the two types of contracts, to varying degrees. However, none of the identified strategies can be described as purely outcome-oriented or behavior-oriented and, consequently, the agency problems in the supply chain of cobalt cannot be fully overcome through either an outcome-oriented or behavior-oriented approach. A pure behavior-oriented contract would entail full transparency in the supply chain which, as shown by the results, is difficult to achieve. A pure outcome-oriented contract would require aligning incentives with all actors in the supply chain that are connected to the focal firm which, given the complexity of the supply chain, is also very difficult to accomplish. As it is unlikely that neither of these two approaches can be implemented, automotive manufacturers should handle the agency problems through using a hybrid approach where a sufficient level of transparency in combination with incentive alignment is adopted. However, the aim of using a hybrid approach should not be to fully eliminate agency problems but instead to minimize them because, in line with Jensen and Meckling (1976), there will always be a risk of agency problems as long as there are principal-agent relationships in the supply chain.

It could thus be argued that the choice of strategy should be made with the intention to minimize the risk of agency problems, hereafter referred to as the *agency risk*, rather than eliminating it

altogether. However, there are other risks that need to be taken into consideration when choosing a strategy, such as the *social sustainability risk*, which can be described as the risk of being exposed to the negative consequences associated with poor social sustainability. Bad publicity in the media or lost business from customers requiring high social sustainability are examples of such negative consequences. Furthermore, some strategies involve a risk associated with making large asset-specific investments since, as described by Clemons (1993), the supplier which the investment is directed towards can exploit this situation by acting opportunistically as the focal firm is unable to re-deploy the investment and thus reluctant to change supplier. This risk will be referred to as the *asset specificity risk*. The size of the investment is also relevant in this case as a larger investment makes the focal firm even more reluctant to change supplier, which means that the asset specificity risk increases.

Strategies that handles agency problems and social problems to a higher degree, and thus decrease the agency risk and social sustainability risk, will likely require larger asset-specific investments, which increases the asset specificity risk. Hence, the selection of a strategy for socially sustainable sourcing of cobalt is not a question of minimizing all three risks, but rather how to balance them. It is, however, not possible to find a strategy that gives an optimal balance of the risks since different firms will likely have different attitudes to the different risks, meaning that one firm might be willing to take on a higher level of one of the risks compared to another firm.

It is possible to distinguish the direct and indirect strategies in terms of the levels of the three risks. The direct strategies are more resource intensive and generally characterized by higher asset specificity, compared to the indirect strategies, and thus have a higher exposure to the asset specificity risk. However, the indirect strategies are arguably more exposed to the social sustainability risk since they have a less active approach to addressing the social problems, meaning that they, unlike the direct strategies, do not take concrete action in the upstream of the supply chain to increase social sustainability. Both Anisul Huq et al. (2014) and Grimm et al. (2016) emphasize working with sub-suppliers to increase sustainability in the supply chain. The direct strategies also contain more elements of assessment of and collaboration with suppliers compared to the indirect strategies, which Grimm et al. (2016) and Sancha et al. (2016) highlight as important measures to increase sustainability. The less active approach associated with the indirect strategies also means that they do not minimize the agency problems to the same extent that the direct strategies do. Delegation of responsibility is the fundamental reason why agency problems occur, and the direct strategies do not delegate responsibility to the same extent as the indirect strategies do. The direct strategies instead aim to overcome the agency problems as the focal firm takes more control over the supply chain and, in some cases, aligns incentives. Hence, the indirect strategies are also more exposed to agency risk.

The fact that the focal firm assumes more control over the supply chain with the direct strategies is also illustrated by the different governance styles of the indirect and direct strategies. The indirect strategies can arguably be associated with market governance, as sub-suppliers are only governed through the first-tier supplier and are chosen, for instance through initial audits, rather than collaborated with. It can, furthermore, be argued that the direct strategies are associated with hierarchical governance, as they are characterized by direct communication with, and increased

control over, upstream suppliers. This is in line with Anisul Huq et al. (2014) who argue that a market governance style is characterized by supplier selection rather than development, while under hierarchical governance, a dominant actor controls and directs the flow of material. Both Anisul Huq et al. (2014) and Jiang (2009) recommend hierarchical governance when working to improve the social sustainability of suppliers in developing countries, which further strengthens the argument that the direct strategies are superior at mitigating the social sustainability risk compared to the indirect strategies. However, both articles study supply chains with less complexity than the supply chain of cobalt, which makes the argument for hierarchy less compelling in this case as the cost of achieving a high level of hierarchical governance will then likely be high.

6.2 COMBINING STRATEGIES

The direct strategies can successfully be combined with each other. The capacity building and incentive schemes strategies should preferably be used together with direct procurement. The incentive schemes strategy is difficult to implement in practice without buying the material directly from the actor at which the incentives are being implemented. Capacity building should preferably be used together with direct procurement, as this strategy implies high asset specificity, which makes it worthwhile to have it protected by the hierarchical governance of direct procurement. It could also be argued that the direct procurement strategy should not be used in isolation either, as this would imply market governance in terms of supplier selection, where only compliant suppliers are chosen. Instead of choosing only compliant suppliers, the focal firm should work together with the supplier to facilitate improvements, which can be achieved by combining direct procurement with capacity building or incentive schemes. However, if social sustainability is not the primary goal with the direct procurement strategy, the strategy can be worthwhile in isolation. This would be the case if the focal firm aims to secure the availability of cobalt rather than actively striving for social sustainability improvements.

When direct procurement is used in isolation, it is most advantageous to direct it towards a smelter or LSM actor since they typically produce and aggregate large quantities of cobalt. However, if it is combined with either incentive schemes or capacity building, it can also be worthwhile to direct it towards ASM and, thereby, address the core social problems in the cobalt supply chain. Whether incentive schemes or capacity building should be used is situational. Incentive schemes are particularly useful when the supplier does not consider that the potential gains of improving their social sustainability standards are large enough, in other words when the supplier is not sufficiently incentivized to make improvements. Capacity building, on the other hand, is especially useful when the supplier is incentivized to improve social sustainability but lack sufficient resources or know-how to do so.

All strategies arguably need to be combined with some measures to improve supply chain transparency to be successful. However, the appropriate level of transparency varies depending on whether a direct and indirect strategy is adopted. It could be argued that the direct strategies require a higher level of transparency since these strategies imply that the focal firm implements measures towards a specific upstream actor to improve social sustainability. The focal firm must then have transparency over the part of the supply chain that lies in between themselves and the

supplier if they want to ensure that material from this supplier ends up in their products, which is generally the case. The level of transparency needed also varies between different direct strategies nonetheless. Using incentive schemes implies that the part of the supply chain which lies further upstream of the supplier where the incentive scheme is adopted requires less, if any, transparency since incentive schemes are outcome-oriented. With the reasoning described above, indirect strategies would require lower levels of transparency since they only involve cooperation with the first-tier supplier. On the other hand, the indirect strategies imply that the first-tier supplier is given more authority to ensure that material is sourced responsibly, which creates a power imbalance between the focal firm and the first-tier supplier. Adopting a transparency strategy could then be a way to reduce the power imbalance as it gives the focal firm more insight into how the first-tier supplier is acting. However, this requires that the first-tier supplier is willing to give the focal firm more insight over how it is acting, and it is unclear whether the first-tier supplier is willing to do that.

Unlike the aforementioned strategies, the adoption of horizontal leverage and ASM approach is less unclear. These strategies can thus be combined with either direct or indirect strategies. As described in the results, there are no major contradictions to using horizontal leverage as it is thought to be advantageous when improving social sustainability by making the aforementioned strategies more effective. The remaining questions are, however, how and to what extent horizontal leverage should be implemented. Regarding the approach to ASM, literature, secondary data, as well as primary data, all unanimously stress that ASM disengagement has negative effects on the social sustainability in the DRC and that firms instead should work to improve the situation rather than avoid ASM altogether. However, companies, such as BMW and Umicore, are still actively working to remove cobalt from ASM, or the DRC altogether, from their supply chains of cobalt (Onstad, 2019; Umicore, 2019). Even if these actions may have a negative effect on the situation in the DRC, it can still reduce the social sustainability risk, as these companies effectively are disconnected from the issues in the DRC. However, as the demand for cobalt is projected to increase, the DRC, as well as ASM, will likely take an even more prominent role coming years. Hence, it will likely be increasingly difficult to avoid the cobalt from ASM or the DRC.

6.3 CONTEXTUAL FACTORS

The specific contextual factors surrounding the focal firm, in this case Alpha, also needs to be considered when choosing a strategy. There are likely multiple contextual factors that affect the choice of strategy, but only one, future dependency on cobalt, will be covered here due to the limited amount of empirical data. Additional potential contextual factors will be accounted for in section 7.2. Future dependency on cobalt refers to how long into the future the firm will be dependent on using cobalt in their products. In general, a higher future dependency on cobalt would favor a more ambitious approach which, in this case, is equivalent to a direct strategy. The focal firm's exposure to the social sustainability risk is likely to increase with a longer timespan as connections between the focal firm and social problems among their sub-suppliers will probably take time to discover. Hence, a higher future dependency of cobalt implies a higher social sustainability risk which means that it is favorable to adopt a direct strategy since the social

sustainability risk is then addressed to a larger extent. Furthermore, the direct strategies are disadvantageous to use with a low dependency on cobalt as they generally have a high asset specificity. Hence, as the indirect strategies have lower asset specificity, resources invested in these strategies can be more easily re-deployed and used for other purposes, which is not the case, at least to the same extent, for direct strategies. The possibility to re-deploy resources would be more important if the cobalt dependency would be short-lived. Moreover, the fact that the direct strategies require investments of more resources, compared to the indirect strategies, in combination with the inability to re-deploy resources reinforces that the direct strategies are unsuitable to use with a low cobalt dependency. However, it is difficult to say exactly how long the future dependency on cobalt must be for the direct strategies to be favorable over the indirect strategies. It is, as described in chapter three, unlikely that cobalt will be removed from EV-batteries altogether before 2030, but whether this is a long enough time is not clear.

6.4 CONCLUDING REMARKS

This chapter has discussed that the choice between a direct and indirect strategy both involves considering what risks the firm is willing to take on and the contextual factors surrounding the firm. It is important to note, however, that these two perspectives might give different results in terms of what strategy to choose, in which case the firm must choose to prioritize a strategy that either matches their attitude towards the risks to a larger extent or a strategy that addresses their contextual factors better. It should also be noted that the choice between a direct and indirect strategy is somewhat of a simplification as it could be possible to combine measures from the indirect and direct strategies. Directed buy could, for instance, be combined with capacity building.

On a final note, it is important to once more stress the fact that the social problems related to cobalt are complex and will likely prevail over the foreseeable future as they are rooted in the structural problems in the DRC, such as poverty. Increasing social sustainability in the cobalt supply chain should, therefore, not be addressed through simple one-off measures but instead through a long-term approach. However, adopting a long-term approach should not stand in conflict with taking short-term action. The approach should thus be similar to what is suggested by Wu and Pagell (2011), namely that sustainability strategies are successful when firms take a sequence of inter-related decisions over time as a sequence of inter-related activities implies both short-term action and a long-term perspective.

7 CONCLUSION & FUTURE RESEARCH

This chapter is divided into two parts where the first part consists of a conclusion where the study's research questions are answered while the second part includes suggestions for future research.

7.1 CONCLUSION

This section answers the two research questions laid out in chapter one.

1. *What are the agency problems that affect social sustainability in the supply chain of cobalt?*

The agency problems are present in the form of information and incentive asymmetries. Information asymmetries create issues for social sustainability since it becomes difficult for an automotive manufacturer to know which actors in the supply chain are causing social problems and whether the automotive manufacturer indirectly sources cobalt produced by these actors. Asymmetric information is mainly a result of the complexity of the supply chain of cobalt, but also a consequence of some actors, such as buying centers, that does not want to disclose certain information as it can be disadvantageous for them to do so. Incentive asymmetries mean that actors in the supply chain are unequally incentivized to improve social sustainability. Downstream companies appear to have similar commitments to improve the social problems whereas actors far upstream in the supply chain, such as LSM and ASM actors, appear to be less incentivized to improve social sustainability.

2. *What strategies are suitable for an automotive manufacturer to manage social sustainability in the supply chain of cobalt?*

Possible strategies that an automotive firm can implement can be divided into indirect and direct strategies, complemented by approaches to ASM, horizontal leverage and supply chain transparency. The indirect strategies include delegation to first-tier supplier and directed buy while the direct strategies include capacity building, direct procurement and incentive schemes.

Figure 7.1 summarizes the study's main findings in terms of strategy selection and recommendation in a conceptual framework. The first part of the framework shows that the choice between a direct and indirect strategy depends on both the firm's attitude towards three different risks and the contextual factors surrounding the firm. In terms of attitude towards risk, the choice of strategy is a question of what risks the automotive manufacturer is willing to expose them self to and which ones they want to reduce. The direct strategies are likely better at addressing the social sustainability problems and agency problems in general compared to the indirect strategies. However, the direct strategies are presumably more resource-intensive and characterized by high asset specificity, compared to the indirect strategies. The direct strategies thus reduce risks related to social sustainability and agency problems to a larger extent than the indirect strategies but are more exposed to the risk associated with asset specificity. Hence, if a firm is highly reluctant to take on the agency and social sustainability risks but more willing to

accept the asset specificity risk, they should opt for a direct strategy. If the firm has an opposite risk profile, meaning that they have a low agency and social sustainability risk aversion but a high asset specificity risk aversion, they should choose an indirect strategy.

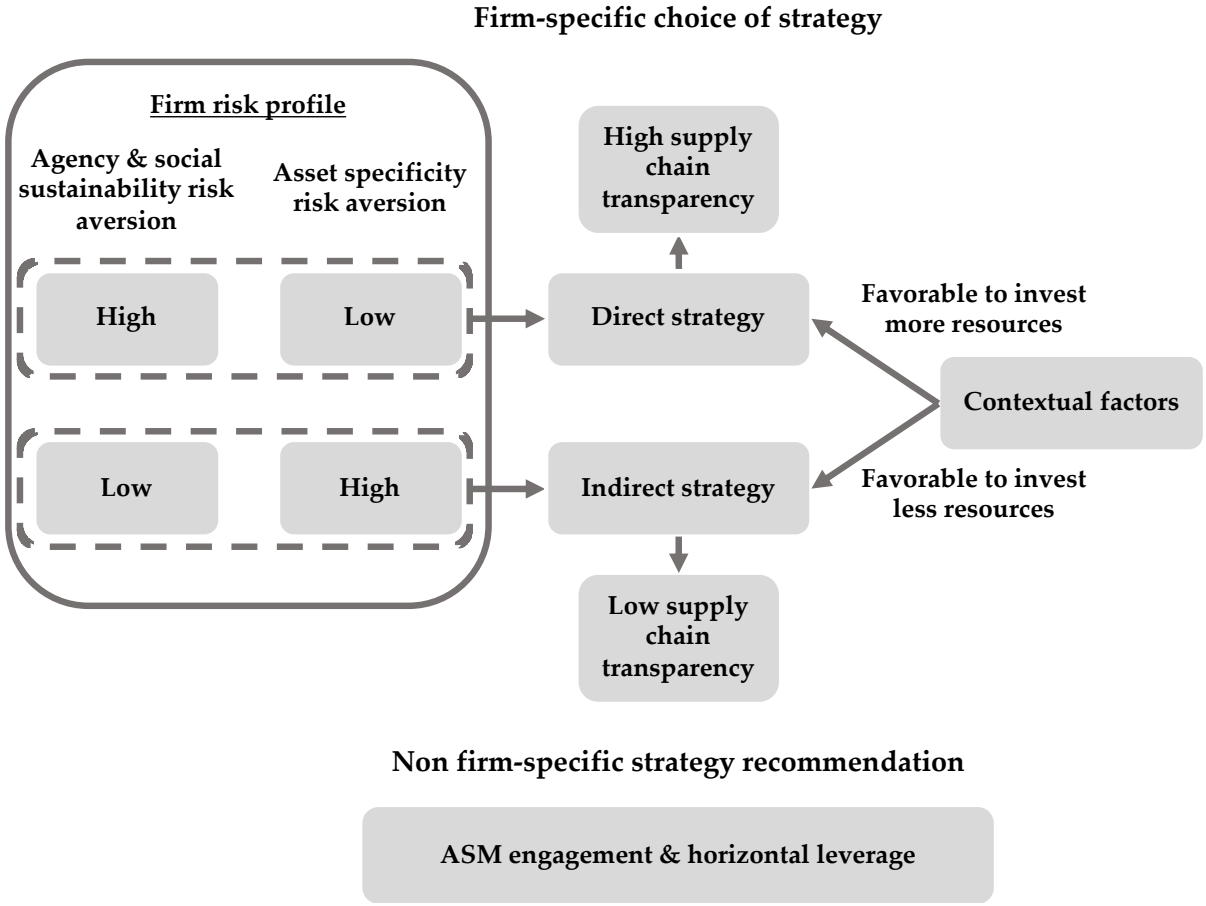

Figure 7.1: Conceptual framework for strategy selection and recommendation.

The contextual factors can either indicate that it would be more or less favorable to invest resources in a social sustainability strategy for cobalt. If the factors indicate that it would be more favorable to invest resources in the strategy, the firm should choose a direct strategy, whereas, if they indicate that it would be less favorable to invest resources in the strategy, the firm should select an indirect strategy. Only one contextual factor was identified in the study's findings namely, cobalt dependence, where a high cobalt dependence would indicate that it would be favorable to invest more resources in the strategy. However, there are likely additional contextual factors, which will be accounted for in section 7.2. The framework also shows that if a direct strategy is chosen, it is recommended to adopt a high supply chain transparency, such as the traceability strategy, while if an indirect strategy is chosen, the firm can opt for lower transparency. The second part of the framework illustrates the strategic approach which is recommended regardless of the firm's risk profile and contextual factors, namely ASM engagement and horizontal leverage.

The framework does, however, not illustrate how the specific direct or indirect strategies can be implemented. Automotive manufacturers who adopt a direct strategy are recommended to combine direct procurement with capacity building or incentive schemes. Incentive schemes are

difficult to implement if not combined with direct procurement and capacity building is also suggested to be combined with direct procurement to have the investment of the strategy protected. Direct procurement will likely have a relatively low impact on improving social sustainability if not combined with incentive schemes or capacity building and is, therefore, not recommended to be used in isolation.

7.2 FUTURE RESEARCH

There are areas that are not fully explored in this study which are suitable for future research. Mainly, contextual factors that may affect the choice of strategy should be examined more thoroughly to be able to make a more precise recommendation.

Future research should examine how long the dependency on cobalt must extend for a direct strategy to be favorable over an indirect strategy, in which case the specific amounts needed to be invested in either a direct or indirect strategy needs to be taken into consideration. Optimally, the return on investment over the given time period could then be calculated and compared for the different strategies. However, this approach is not trivial as the positive outcome of using the strategies is likely complicated to quantify.

The strategies' effect on the availability of cobalt should also be examined further, as some data indicate that a shortage of cobalt can be an issue in the future. The direct strategies could, for instance, be beneficial in securing a sufficient amount of cobalt in the future, especially if direct procurement is adopted towards a smelter or LSM actor. Hence, the ability to secure enough cobalt could also be considered as a contextual factor that might affect the choice of strategy.

Additionally, future research should compare the social sustainability problems of cobalt with those of other metals. Even though cobalt is the metal in EV-batteries with the most widespread reporting of social sustainability problems in its supply chain, other metals also suffer from these issues. Future research should thus compare cobalt with other metals that are, for instance, also used in EV-batteries, such as nickel, lithium and manganese, to determine what social sustainability investments are worthwhile to make for cobalt. A similar investigation conducted for cobalt in this study could thus also be conducted for the other metals to explore how social problems and agency problems in their supply chains could be addressed. The severity of the problems for the different metals and the focal firm's ability to address them could then be taken into consideration when making a comparison. Other factors, such as availability and future dependence of the metals, should also be acknowledged. The comparison between other metals could then act as a contextual factor that can be considered when choosing a strategy.

This study has only focused on the part of the supply chain that lies upstream of the focal firm. It could also be relevant to investigate social sustainability from the end customers' perspective to determine what social sustainability investment is relevant to make for cobalt. This can be done by including how important social sustainability is to the end customers as a contextual factor. A larger investment in social sustainability of cobalt could then be justified if the end customers place great importance on social sustainability, and vice versa.

Finally, due to the explorative nature of the study, the relationships that have been identified in the study, such as those between recommended strategy and an automotive manufacturer's risk profile, are predictions based on the theoretical framework developed in this study. To what extent they are actual relationships is unknown as there is insufficient empirical data to make such claims. Future research can thus focus on gathering empirical data to investigate the relationships laid out in this study.

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