Sustainable Purchasing in the Automotive Industry: Strategies and Practices in Sub-Supplier Management

Marvin Andreas Kumlin

Dissertation written under the supervision of Peter V. Rajsingh (CLSBE) and Fabienne Fel (ESCP)

Dissertation submitted in partial fulfilment of requirements for the MSc in International Management, at Universidade Católica Portuguesa and for the MSc in Management at ESCP Business School, 31.05.2024.

Abstract

Firms need to take responsibility for the environmental and social performance of their supply chain due to changing regulations and growing stakeholder pressures. Since many parts of the value creation are outsourced across multiple supply chain tiers, companies need to adapt their supplier and sub-supplier management strategies. Hence, firms need to decide how much of the supply network to delegate and how much of it to directly control.

The results of qualitative research show that the social sustainability dimension is subject to less fluctuations. Whereas environmental requirements may vary depending on the products and projects. OEMs mainly employ delegation practices, as they require first-tier suppliers to enforce sustainability requirements and cascade them down the supply chain. This results in a model of delegation across the supply chain. Each tier is accountable to ensure that the next tier complies. Sub-supplier management strategies are adapted based on factors like sustainability risk, product criticality, or detected violations. Automotive companies utilize sustainability scores, certifications, supplier audits, supplier development practices, and directed buys to drive the adoption of sustainability among their suppliers and sub-suppliers. However, the implementation of sustainability requirements varies across supply chain tiers as lower-tier suppliers rarely implement sustainability mandates.

Keywords: Sustainability; Sub-Supplier Management; Sustainable Purchasing; Supply Chain Management; Supplier Assessment and Supplier Development

Title: Sustainable Purchasing in the Automotive Industry: Strategies and Practices in Sub-Supplier Management

Author: Marvin Andreas Kumlin

Sumário

As empresas precisam de assumir a responsabilidade pelo desempenho ambiental e social da sua cadeia de abastecimento devido às crescentes pressões dos interessados. Uma vez que muitas partes da criação de valor são externalizadas em vários níveis da cadeia de abastecimento, as empresas precisam de adaptar as suas estratégias de gestão de fornecedores e subfornecedores. Assim, as empresas têm de decidir quanto da rede de abastecimento devem delegar e quanto devem controlar diretamente.

Os resultados da investigação qualitativa mostram que a dimensão da sustentabilidade social está sujeita a menos flutuações. Já os requisitos ambientais podem variar consoante os produtos e os projectos. Os fabricantes de equipamento original utilizam principalmente práticas de delegação, uma vez que exigem que os fornecedores de primeiro nível apliquem os requisitos de sustentabilidade e os transmitam em cascata ao longo da cadeia de abastecimento. Isto resulta num modelo de delegação ao longo da cadeia de abastecimento. Cada nível é responsável por garantir que o nível seguinte cumpre os requisitos. As estratégias de gestão dos subfornecedores são adaptadas com base em factores como o risco de sustentabilidade, a importância do produto ou as violações detectadas. As empresas do sector automóvel utilizam pontuações de sustentabilidade, certificações, auditorias a fornecedores, práticas de desenvolvimento de fornecedores e compras dirigidas para promover a adoção da sustentabilidade entre os seus fornecedores e subfornecedores. No entanto, a implementação de requisitos de sustentabilidade varia consoante os níveis da cadeia de fornecimento, uma vez que os fornecedores de nível inferior raramente implementam mandatos de sustentabilidade.

Palavras-chave: Sustentabilidade; Gestão de Subfornecedores; Compras Sustentáveis; Gestão da Cadeia de Abastecimento; Avaliação de Fornecedores e Desenvolvimento de Fornecedores

Título: Compras sustentáveis na indústria automóvel: Estratégias e Práticas na Gestão de Subfornecedores

Autor: Marvin Andreas Kumlin

Acknowledgements

This dissertation finishes an important step in my life and academic career. It is the end of my Master's journey and the beginning of my future career.

First, I would like to thank my two thesis supervisors Fabienne Fel from ESCP Europe and Peter V. Rajsingh from Católica Lisbon School of Business & Economics. Their support, guidance, and insights have been invaluable for the completion of this research.

Second, I would like to express my gratitude to all interviewed experts. Their insights and expertise have elevated the quality and depth of my research.

Last but not least, I would like to thank my friends and family for their incredible support. Without them, this journey would not have been possible.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AI = Artificial Intelligence

ASSA = Assessment Sharing Strategic Alliance

DCT = Dynamic Capability Theory

EU = European Union

GM = General Motors

KPI = Key Performance Indicator

NGO = Non- Governmental Organization

OEM = Original Equipment Manufacturer

R&D = Research and Development

RBT = Resource-Based Theory

RFID = Radio Frequency Identification

SAQ = Self- Assessment Questionnaire

SCM = Supply Chain Management

SQM = Supplier Quality Management

SSCM = Sustainable Supply Chain Management

TBL = Trible Bottom Line

Tier 1 = First-Tier Supplier

1. Introduction

1.1 Background & Problem

Sustainability is reshaping global business operations and the way corporations operate. This is highlighted by the Forbes article, "Why corporate strategies should be focused on sustainability" (Rafi, 2021). The topic of sustainability is established as a "necessity" for firms due to changes in stakeholder preferences, legislation, and economic trends. Consequently, firms cannot afford to neglect sustainability within their business operations. This significantly impacts automotive companies, as historically, they have been a major contributor to sustainability issues. Since the automotive industry is one of the largest and most influential industries, it holds a significant position and responsibility within global and automotive supply chains (Mathivathanan, Kannan & Haq, 2018). This signifies the importance of supply chain management as carmakers try to enhance their environmental and social sustainability impact.

Legislative changes within the realm of supply chain management show the importance of sustainability. According to the German Supply Chain Due Diligence Act, companies that are based in Germany and with over 1.000 employees are mandated to establish a social and environmental due diligence process to prevent and address potential issues (LkSG, 2021). Similarly, the EU is in the process of updating its regulatory framework. The proposed EU Supply Chain Act will incorporate social and environmental supply chain mandates for companies that operate within the EU (European Commission, 2022). These shifts in regulations emphasize the growing pressures on firms to take responsibility for the environmental and social performance of their supply chain. Overall, "a company is no more sustainable than the suppliers from which it sources" (Krause, Vachon & Klassen, 2009). However, as many parts of the value creation are outsourced and the total purchased costs can amount to 60-80% of total manufacturing costs, firms need to adapt their supplier and sub-supplier management strategies adequately (Koplin, Seuring & Mesterharm, 2007; Xu et al., 2013).

The management of sustainability within supply chains is a complex endeavor. Therefore, firms mainly focus on the management of direct suppliers (Grimm, Hofstetter & Sarkis, 2016). However, the supply chain network typically consists of an extensive number of global actors across different tiers. Consequently, supply chain links can extend beyond the direct control and ownership of focal firms (primary entities within the supply chain, such as OEMs).

Moreover, up to 90% of supply chain violations occur in lower supply chain tiers, especially in developing countries (Meinlschmidt, Schlepper & Foerstl, 2018; Tachizawa & Wong, 2014). The importance of sub-supplier management is emphasized by the implications of the "chain liability effect". It implies that focal firms are being held responsible for sustainability violations within their supply chain. This is even the case when violations are committed by suppliers and sub-suppliers beyond the direct reach and control of firms. It is explained by the fact that the focal firm is the most visible part of the supply chain, and it is thus the primary interface for consumers and stakeholders (Meinlschmidt, Schlepper & Foerstl, 2018; Hartmann & Moeller, 2014). This is exemplified by the metaphor of the iceberg, where the greatest threat regarding sustainability violations remains hidden in lower supply chain tiers (Meinlschmidt, Schlepper & Foerstl, 2018). Exemplary, General Motors (GM) faced a serious backlash for the actions of a sub-supplier in August 2014. Dust build-up and insufficient ventilation caused the death of 97 workers and injuries to further 163 people. Regardless of the fact, that GM did not have any direct relationship with the supplier, their reputation was seriously impacted. They faced grave public attention which signifies the importance of sub-supplier management (Villena, 2019).

Thus, corporations need to reevaluate their supply chain and sub-supplier management. However, no firm is powerful enough to manage its whole multi-tiered supply chain (Wilhelm et al., 2016b). Therefore, firms need to apply various strategies to manage their supply chain and sub-suppliers. This will be addressed in the thesis through the following research question:

"How can automotive companies influence the adoption of sustainability practices amongst sub-suppliers in multi-tiered supply chains?"

1.2 Objective

The objective of this thesis is to understand how the environmental and social dimensions of the triple bottom line are integrated into sub-supplier management practices. Thereby, the thesis aims to investigate the delegation and direct management practices employed within the industry. In the context of delegation, it is crucial to establish the role of the suppliers and sub-suppliers and how the sustainability criteria are cascaded through the supply chain. Moreover, within direct management practices the thesis aims to understand how and when OEMs engage in sub-supplier assessment and collaboration practices. With this targeted approach, the goal is to add to the ongoing conversation around sustainable supply chain management and purchasing. By establishing how the social and environmental dimensions are being operationalized in the context of sub-supplier management and the automotive industry, the thesis attempts to fill the identified research gap.

1.3 Methodology & Outline

The thesis begins with a literature review to establish the foundation for the empirical analysis. To generate an overview of the existing theories and relevant academic articles, a search was conducted based on keywords like sustainability, purchasing, procurement, supply chain management, multi-tiered supply chain, sub-suppliers, and triple bottom line.

A quantitative approach was chosen to build upon the theoretical foundation. To address the identified research gap and analyze the identified sub-supplier management strategies, interviews with industry professionals across the automotive supply chain tiers were conducted. The gathered empirical data was analyzed and discussed in the context of the literature review. Thereby, the existing academic knowledge could be either validated, contradicted, or extended.

2. Literature Review

The literature review lays the foundation for the concept of sustainability by focusing on environmental and social purchasing criteria. The different strategies, challenges, and key success factors of sub-supplier management in the context of sustainability are then discussed. In particular, the role of the first-tier supplier and sub-supplier assessment and development practices are examined. The literature review concludes with a detailed look at the automotive industry.

2.1 Sustainability

Sustainability can be defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (The Brundland Report, 1987). In the business context, sustainability is commonly defined along the “Triple Bottom Line” (TBL). This framework was proposed by Elkington (1997) and evaluates a company based on three interconnected dimensions: economic, social, and environmental. To ensure sustainability, firms need to consider multiple variables and parameters across the three dimensions. The "economic bottom line" incorporates the financial performance and profitability of firms. The "environmental bottom line" deals with companies' ecological impact and the maintenance of the ecosystem’s integrity. The "social bottom line" evaluates the contribution of firms to social equity, welfare, and community (Elkington & Rowlands, 1999). To balance these three factors poses a major challenge within sustainability and supply chain management. Thus, to achieve environmental and social sustainability, companies must continuously reevaluate their actions and those of their suppliers (Elkington & Rowlands, 1999).

2.2 Sustainable Purchasing

Sustainable supply chain management is described as the “management of material, information, and capital flows as well as cooperation among companies along the supply chain while taking goals of all three dimensions of sustainable development, i.e. economic, environmental and social, into account which are derived from customer and stakeholder requirements” (Seuring & Müller, 2008). It is a journey and not a destination as supply chains evolve and learn over time. Therefore, the supply chain cannot be seen as linear, but rather as a dynamic and complex network between organizations (Silvestre, 2015). Hence, for the supply chain to be sustainable, every member must be sustainable. It is important to manage the entire

supply chain and not only its final stages. This emphasizes the pivotal role of purchasing in sustainable supply chain management (Seuring & Müller, 2008). Sustainable purchasing can be defined as: "the process used to secure the acquisition of goods and services in a way that ensures that there is the least impact on society and the environment throughout the full life cycle of the product" (Meehan & Bryde, 2011). Historically, sustainability efforts within the TBL framework concentrated on environmental concerns. However, there is a shift towards the social dimension of sustainability. This evolution underscores the importance of social factors alongside environmental considerations within sustainability strategies (Zorzini et al., 2015; Silva & Ruel, 2022).

2.2.1 Environmental Sustainability in Purchasing

Environmental management can be defined as a "consistent set of administrative and operational policies and practices that consider the protection of the environment through the mitigation of environmental impacts and damage resulting from planning, implementation, operation, expansion, reallocation or deactivation of ventures or activities, including all of the product's life cycle phases" (Jabbour and Jabbour, 2009). Thus, environmental purchasing describes the integration of environmental factors into the purchasing process to reduce the environmental impact across the supply chain (Shen et al., 2013). The table below shows the environmental criteria that are related to sustainable purchasing within supply chain management:

Criteria	Variables	Sources
Pollution	Solid Waste (e.g., scrap & components); Chemical Waste; Air Emission; Water Pollution; Soil Pollution	Zimmer, Fröhling & Schultmann (2016); Luthra et al. (2017); Menon & Ravi (2022); Govindan, Khodaverdi & Jafarian (2013); Sarkis & Dhavale (2015); Humphreys, Wong & Chan (2003);
Consumption	Raw Materials; Energy; Water	
Eco-Design	Product Design; Recycling/Reuse/Remanufacture/Disassembly/Disposal; Use or Buying of Env. Friendly Material/Technology	
Management Structures & Competencies	Environmental Management System; Certification & Environmental Compliance; Environmental Policies; Trainings	

Table 1: Environmental Purchasing Criteria

2.2.2 Social Sustainability in Purchasing

The social sustainability dimension describes the management of social resources and the development of processes to improve human and societies well-being (Govindan, Shaw & Majumdar, 2021; Huq, Chowdbury & Klassen, 2016). However, the impact of social criteria is difficult to quantify. Therefore, human rights, safety systems, and occupational health are given

prominence (Menon & Ravi, 2022). The table below presents the social criteria that are related to sustainable purchasing within supply chain management:

Criteria	Variables	Sources
Human Rights & Labor Practices	Child Labor; Compliance with Human Rights & Labor Laws; Fair Wages; Education and Training; Diversity & Anti-Discrimination; Certifications	Luthra et al. (2017); Menon & Ravi (2022); Govindan, Khodaverdi & Jafarian (2013); Zimmer, Fröhling & Schultmann (2016)
Safety Systems & Occupational Health	Working Times/ Excessive Overtime; Injuries & Deaths at the Workplace; Healthcare and Disability Benefits; Exposure of Employees to Harmful Environments/Materials; Absence/Insufficiency/Existence of Health and Safety Protections	
Community Engagement	Donations and Grants to Local Communities; Welfare Services	

Table 2: Social Purchasing Criteria

2.2.3 Drivers, Barriers, and Impact of Social Purchasing

The process to understand the dynamics of sustainable purchasing involves the consideration of various internal and external drivers and barriers (Govindian, Shankar & Kannan, 2018).

Internal drivers include top-management support, organizational values, risk mitigation strategies, financial benefits, and achieving competitive advantage (Hoejmose & Adrien-Kirby, 2012; Grimm, Hofstetter & Sarkis, 2014). Regarding external factors, organizations respond to stakeholder pressures (stakeholders include customers, government, NGOs, media, investors, etc.) that demand the adoption of sustainability criteria (Grimm, Hofstetter & Sarkis, 2014). This also includes regulatory changes as it forces companies to manage sustainability within their supply chain to comply with regulations. This is exemplified by the "German Supply Chain Act" and the pending "EU Supply Chain Act" which mandate companies to map and monitor their supply chains for violations of human rights and environmental standards, and to act against any identified abuses (LkSG, 2021; European Commission, 2022).

Internal barriers include the clash with traditional purchasing factors like price and quality, as it often involves higher costs and demands resources, skills, and commitment. External barriers can be the difficulty to influence suppliers (due to low commitment, trust, and transparency levels among supply chain partners), along with cultural and geographical differences (Grimm, Hofstetter & Sarkis, 2014; Silvestre, 2015).

By integrating sustainability into the purchasing process firms may enhance their market share, sales, competitive advantage, supply chain resilience, and customer perception (Govindian, Shankar & Kannan, 2018; Crespin-Mazet & Dontenwill, 2012). Thereby, firms can contribute to a positive brand image and risk mitigation. This is explained by the fact that ethical and sustainable behavior is associated with improved corporate image and reputation, while the violation of such standards may lead to fines and costs (Carter, 2000). Thus, firms can achieve higher levels of performance. Although conflicting findings exist regarding the influence of financial performance (Carter, Kale & Grimm, 2000; Islam et al., 2017).

2.3 Sustainable Purchasing in Multi-Tiered Supply Chains

Overall, sustainable purchasing in multi-tiered supply chains is a complex topic and the adopted strategies can vary. However, sub-supplier management strategies (supplier assessment and development) are similar to direct supplier management strategies (Grimm, Hofstetter & Sarkis, 2014). Nonetheless, it is important to notice that the management of lower-tier suppliers is more difficult due to their characteristics (e.g., no contractual relationship or lower power levels). Nevertheless, the management of lower-tier suppliers is imperative as they tend to adopt a more passive approach towards environmental and social sustainability. Lower-tier suppliers are characterized by lower visibility since they are often smaller firms that experience less stakeholder pressure and are situated in emerging or developing countries with less stringent sustainability regulations (Villena & Gioia, 2018; Jamalnia, Gong & Govindan, 2023). Thus, they face a reduced risk of penalties and public scrutiny. Moreover, new, or upcoming regulations make focal firms responsible for sustainability violations of direct and indirect suppliers if there are no adequate management systems in place. Consequently, it is becoming imperative for focal firms to manage their lower-tier suppliers within the context of sustainability.

2.3.1 Sub-Supplier Management Strategies

Generally, the supply chain extends beyond a single supplier. It consists of numerous suppliers and their respective sub-suppliers. The network spans from the sourcing of raw materials to the entire production process. Hence, effective supply chain management and in this case sustainable purchasing strategies require careful consideration of suppliers and their respective sub-suppliers (Grimm, Hofstetter & Sarkis, 2016). In this context, focal firms expand their sustainability strategies to lower-tier suppliers based on supply chain complexity, the

sustainability management capabilities of first-tier & lower-tier suppliers, the risk of non-compliance, public attention, channel power, and sustainability goals. Thus, the challenge of the focal firm lies first in the identification of their sub-supplier, and then in their evaluation/management (Grimm, Hofstetter & Sarkis, 2016). This results in various adopted sub-supplier management strategies:

Author	SSCM Approach	Description
Mena et al. (2013)	Open Triad	Direct supplier acts as a mediator as the focal company has no direct link with the sub-supplier
	Closed Triad	Focal firm and sub-supplier have a direct, formal relationship with regular interaction and information sharing
	Transitional Triad	Focal firm and sub-supplier are in the process of establishing a direct link, movement from an open to a closed triad structure
Tachizawa and Wong (2014)	Direct	Focal firms engage with sub-suppliers directly to ensure sustainability compliance and performance
	Indirect	Delegation of responsibility to direct suppliers to manage sub-suppliers based on the focal firm´s sustainability standards
	Work with Third Parties	Focal firms delegate the responsibility of setting and monitoring sustainability standards at the sub-supplier level to external entities like governments, NGOs, or industry alliances
	Don´t bother	Focal firms do not engage in sub-supplier sustainability management and focus only on direct suppliers
Meinlschmidt et al. (2018)	Direct-holistic	Focal firms extensively manage sustainability across all tiers
	Direct: product-specific	Focal firms closely manage first-tier suppliers and selectively engage with lower-tier suppliers of critical products
	Direct: region-specific	Focal firms target sustainability efforts at sub-suppliers in regions known for unsustainable practices
	Direct: event-specific	Focal firms reactively address urgent sustainability incidents in their lower-tier supply chain with direct intervention
	Indirect: multiplier-based	Focal firms cooperate with selected suppliers to select, evaluate, and develop suppliers, anticipating that these standards will cascade down to sub-suppliers through a multiplier effect
	Indirect: alliance-based	Focal firms collaborate with industry alliances for auditing and certifying sub-supplier practices and sharing knowledge
	Indirect: compliance-based	Direct suppliers are mandated to enforce the focal firm's sustainability standards on their sub-suppliers according to the focal firm's guidelines
	Neglect: tier-1-based	Focal firms only manage direct suppliers and do not engage with sub-supplier sustainability management

Table 3: Overview Sub-supplier Management Strategies

Mena et al. (2013) proposed three distinct triad structures for the management of sub-suppliers which differ in the degree of direct interactions and formal relationships between supply chain members. First, the “open triad” structure represents a traditional supply chain, whereby the flow of materials and information occurs without a direct link between the focal company and the sub-supplier. Consequently, the role of the direct supplier can be described as that of a mediator. Second, the “closed triad” is characterized by a direct connection between the focal firm and the sub-supplier. This involves the establishment of a mutual relationship. Third, the “transitional triad” represents an intermediary state. The focal firms and sub-suppliers initiate

a direct link to establish a closed triad structure which implies a shift from indirect to direct interactions. Overall, three factors influence sub-supplier management strategies, the supply chain complexity, the sustainability capability of tier-one suppliers, and the sustainability dimension (Wilhelm et al., 2016b). Firms employ the “open triad” method when they are confident in the sustainability practices of direct suppliers. In contrast, they utilize the “closed triad” framework in case of high institutional distance, and uncertain sustainability practices (Wilhelm et al., 2016b).

Tachizawa & Wong (2014) proposed an adaptation of the SSCM framework and sub-supplier management. It consists of four approaches with characteristics and prerequisites. First, according to the “direct” approach, focal firms manage their sub-suppliers directly. This includes the direct communication of sustainability requirements, monitoring of sustainability compliance, provision of training, and collaboration to enhance social and environmental sustainability. Second, within the “indirect” approach focal firms rely on direct suppliers as intermediaries as they assess, select, and develop sub-suppliers based on specified sustainability criteria. Third, in the “work with third parties” approach, focal firms delegate the responsibility of sub-supplier management to external organizations like government bodies, NGOs, industry alliances, and certification firms. Fourth, the "don't bother" approach implies that focal firms do not engage in sub-supplier management.

The chosen sub-supplier strategies are influenced by power, stakeholder pressure, material criticality, dependency, distance, industry dynamism, and knowledge resources (Tachizawa & Wong, 2014; Wilhelm et al., 2016b; Gong et al., 2018). Focal firms adopt the "direct" model when they have higher levels of power, stakeholder pressure, material criticality, dependence, supply chain distance, and knowledge resources, but low industry dynamism. However, there are uncertainties surrounding the impact of the knowledge resources. If the knowledge can be easily learned, it does not necessarily impact the adoption of the direct approach (Gong et al., 2018). The "indirect" approach is more likely with higher levels of power, stakeholder pressure, and industry dynamism, but with lower material criticality, supply chain distance, dependence, and knowledge resources. Focal firms adopt the "work with third party" strategy when they are confronted with high stakeholder pressure, material criticality, dependence, and supply chain distance, but low knowledge resources, power, and industry dynamism. They adopt the "Don't bother" approach in cases of high industry dynamism but low power, stakeholder pressure, material criticality, knowledge resources, supply chain distance, and dependency. There is also

an allocation of more resources in the set-up and operating phases and a transition to fewer in the operating and sustaining stages. In concrete terms, during the set-up stage, focal companies map their supply chain and engage in concrete management practices. In the operating stage, they focus on the development of sustainability capabilities, and in the sustaining stage, they delegate the responsibility to Tier 1 suppliers and external partners (Tachizawa & Wong, 2014; Wilhelm et al., 2016b; Gong et al., 2018).

Meinlschmidt et al. (2018) have enriched the sub-supplier management framework proposed by Tachizawa and Wong (2014). They divided the "direct" approach into four categories. The "direct-holistic" approach is characterized by a proactive, and resource-intensive management of lower-tier suppliers. Within the "direct: product-specific" strategy focal firms focus on the management of first-tier suppliers. For critical products, however, they engage directly with lower-tier suppliers. The same applies to the "direct: region-specific" and the "direct: event-specific" approaches, where sub-supplier management is conducted in regions where sustainability challenges are expected or in response to critical events. The indirect approach is divided into three different dimensions. The "indirect: multiplier-based" strategy implies that focal firms cooperate with suppliers to select, evaluate, and develop their suppliers, as they anticipate that these standards will cascade through the supply chain due to the multiplier effect. The "indirect: alliance-based" method states that firms collaborate with alliances and industry associations that conduct sub-supplier sustainability audits, award certification, and share assessment information among members. The "indirect: compliance-based" approach mandates the enforcement of sustainability standards to direct suppliers. The "neglect: tier-1-based" strategy is similar to the "don´t bother" approach as firms do not engage in sub-supplier management.

In general, focal firms select the sub-supplier management approach based on the sustainability risk and the specific business context. Nevertheless, the optimal strategy is one of the extremes - either direct management or delegation (Huang, Song & Swinney, 2022). However, direct sub-supplier management is still the exception and not the rule (Wilhelm et al., 2016b). The goal of supply chain management should not be to control the entire supply network, but rather to decide how much of the supply chain to control and how much of it to delegate (Villena & Gioia, 2018). This is illustrated by the example of Honda. For a limited number of items, they directly manage the supply chain, but for the remaining items they empower their direct suppliers (Villena & Gioia, 2018).

2.3.2 Key Success Factors and Challenges of Sub-Supplier Management

Although sub-supplier management practices are similar to direct supplier management practices, they involve different key success factors and challenges. “The prerequisite for a transparent supply chain and the ability of the focal firm to manage their sub-suppliers is the willingness of their direct supplier to disclose them” (Grimm, Hofstetter & Sarkis, 2014). However, not every supplier is willing or able to disclose its suppliers. This can be attributed to the principal-agent problem, as the agent (direct supplier), hides information from the principal (focal firm). Therefore, trust is crucial for a transparent supply chain partnership (Doney & Cannon, 1997). Thus, higher levels of trust may lead to greater access to sub-suppliers. In contrast, if the trust levels are low, the opposite is the case since suppliers fear to be bypassed (Grimm, Hofstetter & Sarkis, 2014). This fear is amplified when the focal firm can source directly from the sub-supplier and when both the focal firm and sub-supplier have a low level of commitment to the direct supplier. As a certain level of uncertainty always remains, a well-established and long-term relationship between supply chain partners fosters the implementation of sustainability (Villena & Craighead, 2017).

Often there is no contractual relationship between focal firms and sub-suppliers (Grimm, Hofstetter & Sarkis, 2014). As a result, the power of the focal firms to drive the sustainability actions of sub-suppliers is reduced. Furthermore, focal firms can only exert power over their direct suppliers in the context of sub-supplier management if they see the relevance and the added value (Grimm, Hofstetter & Sarkis, 2014). In simple terms, this implies that a supplier/sub-supplier would like to see direct or indirect benefits for their involvement in sub-supplier management practices of focal firms. In addition, many sub-suppliers are located in emerging countries. Thus, the geographical and institutional distance complicates the management of sub-suppliers, as companies often do not share the same rules, norms, and values. This is recognized by the information theory as the contractual and regional distance between a firm and its sub-suppliers contributes to information asymmetry between the firm, its first-tier supplier, and sub-suppliers (Wilhelm et al., 2016b).

To successfully manage sub-suppliers, focal firms need extensive supply chain knowledge. They need to understand the market and market conditions in which they operate to implement sustainability and create a win-win scenario for each supply chain member (Grimm, Hofstetter & Sarkis, 2014). In this context, financial, innovation, manufacturing, and digitalization capabilities are crucial (Khan et al., 2022). However, the capabilities of focal firms are not

enough. For the successful integration of sustainability in the supply chain, direct suppliers and sub-suppliers must also have the capabilities to implement these practices. Their motivation alone is not enough (Grimm, Hofstetter & Sarkis, 2014).

Direct interactions between the purchasing department of buyers and suppliers are important to effectively cascade sustainability standards down the supply chain. Furthermore, there is limited communication between the procurement and sales departments (Villena, 2019). This can lead to a communication gap that leaves suppliers' procurement teams out of the loop. Consequently, this lack of awareness limits the integration of sustainability requirements.

In general, improvements in assessment and collaboration practices result in greater sustainability compliance across the supply chain (Tseng et al., 2019; Najjar & Yasin, 2023). However, it is not sustainable for focal firms to manage their entire supply chain. This highlights the importance of the first-tier supplier (Gong et al., 2018).

2.3.3 The Role of the First-Tier Supplier

Direct suppliers take a mediating role between focal firms and sub-suppliers. This highlights the importance of effective sub-supplier management. In contrast to focal firms, the direct suppliers have an in-depth knowledge of sub-suppliers and consequently, their involvement brings focal firms and the sub-suppliers closer together (Grimm, Hofstetter & Sarkis, 2014). In general, the involvement of first-tier suppliers (1) speeds up the development of mutual trust between the focal firm and the sub-supplier, (2) prevents the impression of being neglected and bypassed, and (3) ensures that the first-tier supplier remains aware of its responsibilities (Grimm, Hofstetter & Sarkis, 2014).

The role of first-tier suppliers can be described as a "Double Agency Role" (Wilhelm et al., 2016a). The primary agency role is to implement the focal firm's sustainability requirements within its operations. The secondary agency role is to cascade them down the supply chain (Wilhelm et al., 2016a). According to the theory, agents act based on self-interest and opportunism which creates challenges for principals. They need to verify the actions of the agents due to information asymmetries and goal conflicts. The effectiveness of the secondary agency role depends on several factors. These include the resource availability for first-tier suppliers, the focal firm's focus on environmental and social sustainability, the use of power,

the competencies, and the internal alignment of sustainability and purchasing functions (Wilhelm et al., 2016a).

2.3.4 The Role of Supplier Assessment Practices

To ensure that suppliers and sub-suppliers comply with sustainability requirements, focal firms adopt supplier assessment practices. They are not only crucial for the process of supplier selection but also for monitoring and development practices (Grimm, Hofstetter & Sarkis, 2014). To assess suppliers and sub-suppliers, focal firms evaluate the performance and adherence to pre-defined sustainability criteria (Grimm, Hofstetter & Sarkis, 2016). They incorporate sustainability criteria alongside traditional criteria, such as costs, quality, lead time, or supplier performance. Thus, suppliers are assessed based on social, environmental, and economic criteria. Due to quantification difficulties and the supply chain complexity, this can be a complex process (Govindian, Shankar & Kannan, 2018; Xu et al., 2013). Therefore, suppliers need to demonstrate their compliance with sustainability standards. Hence, focal firms demand signed codes of conduct, certifications, self-assessment questionnaires, and audits (Grimm, Hofstetter & Sarkis, 2014).

Codes of conduct can be described as a set of guidelines and principles that outline the expected behavior of individuals or organizations. In the context of sustainable purchasing, they include various social, environmental, and ethical requirements that must be implemented by suppliers (Mamic, 2005; Awaysheh & Klassen, 2010). Focal firms demand adherence to these codes of conduct as it demonstrates awareness and commitment to sustainable business practices. This creates trust, transparency, and accountability (Mamic, 2005; Awaysheh & Klassen, 2010). In addition, it fosters the compliance and commitment of suppliers since these sustainability criteria are a requirement to qualify as a supplier (Huq, Chowdhury & Klassen, 2016). However, their effectiveness is doubted as they tend to address superficial compliance and do not delve deeper into the underlying issues. This is explained by the fact that focal firms only provide suppliers with guidelines without ensuring that they can implement them (Hoejmose & Adrien-Kirby, 2012). Moreover, suppliers often only adopt the minimal requirements that are demanded by the codes of conduct to avoid detection. Hence, to achieve long-term sustainability improvements, firms need to transition from confrontational approaches to collaborative efforts (Huq, Chowdhury & Klassen, 2016). Nevertheless, despite these hurdles, codes of conduct serve as an important factor within sustainable sub-supplier management. They can act as leverage, but they need to be rigorously implemented and monitored to

contribute to the advancement of sustainable practices. Furthermore, any detected violations can result in penalties and the termination of contracts (Awaysheh & Klassen, 2010).

Certifications and sustainability scores can be considered standardized benchmarks for sustainability practices. Organizations rely on them as tangible evidence of a supplier's commitment to specific sustainability standards. (Grimm, Hofstetter & Sarkis, 2016). They signal legitimacy and provide assurances for compliance with environmental and social purchasing criteria. Thereby, they mitigate risks as they assure that each "member" adheres to these internationally recognized standards (Beske, Koplin & Seuring, 2008). Certifications ease sustainable sub-supplier management as they can streamline the due diligence process by reducing the need for individual audits, and by fostering transparency. This is especially valuable in complex supply chain settings that can span across different geographical and regulatory landscapes (Grimm, Hofstetter & Sarkis, 2016). Examples of such certifications are:

Certifications	Explanation
SA8000	Global certification for fair and ethical treatment of workers, covering areas like labor rights and workplace safety. It's awarded by third-party audits from SAAS-accredited certification bodies and is overseen by Social Accountability International (SA8000,
ISO14001, which is part of the ISO14000 family	Focus on environmental management systems. Companies earn this certification through third-party audits that verify their compliance with environmental policies, legal requirements, and continuous performance improvement (ISO14001, 2024).
ISO45001	This standards mandates an occupational health & safety management system. Key elements include leadership commitment, worker participation, hazard identification and risk assessment, legal and regulatory compliance, emergency planning and incident investigation (ISO45001, 2024).
ECOVADIS	Evaluation of companies regarding the sustainability of their supply chains, covering environmental, labor, ethics, and supply chain practices (EcoVadis, 2024).

Table 4: Overview Sustainability Certifications

Organizations adopt supplier auditing practices to assess and verify the adherence of suppliers to predefined sustainability criteria. Therefore, assessment practices contribute to the establishment of transparent and responsible supply chains (Plambeck & Taylor, 2016). This not only helps to mitigate potential violations but also fosters the continuous improvement of sustainability within the supply chain (Grimm, Hofstetter & Sarkis, 2014). It holds suppliers accountable for their sustainability efforts (especially in regions where regulatory institutions are weak) and it promotes transparency, accountability, and the integration of sustainability throughout the supply network. (Plambeck & Taylor, 2016). In general, within the supplier auditing process, suppliers are carefully evaluated based on their processes, documentation,

overall management systems, and on-site experiences. To conduct audits, organizations can choose between an internal team or third-party auditors (Huq, Chowdhury & Klassen, 2016). This decision is often influenced by factors such as resource limitations, complexity, and the geographic location of suppliers. While third-party auditors are widely considered to be more competent, credible, and transparent, some organizations opt for internal audit teams to better understand suppliers' limitations and foster trust (Huq, Chowdhury & Klassen, 2016). Despite that, there are also potential drawbacks of relying on third-party auditors. Firms can only control and impact the audits of third parties to a certain extent and there might be potential biases or conflicts of interest due to financial incentives tied to the audit outcome (Huq, Chowdhury & Klassen, 2016). Moreover, regardless of internal or external audit teams, suppliers may resort to deceptive practices to pass audits which limits its effectiveness (Plambeck & Taylor, 2016). Nevertheless, by assessing suppliers, firms can reduce the risk of sustainability violations (Gimenez & Sierra, 2012).

Focal firms can rely on third parties beyond auditing practices. These interactions can be separated into two sub-supplier management approaches. The delegation to external organizations (e.g., NGOs), and the formation of strategic alliances and industry associations (Tachizawa & Wong, 2014). In the context of strategic alliances and industry associations, Assessment Sharing Strategic Alliances (ASSA) can be formed among companies within the same industry. The goal is to exchange sustainability assessment practices and results for suppliers that are in common. Thereby firms can combine resources and benefit from each other’s knowledge and reach. This is particularly relevant in complex and multi-tiered supply chains (Lechler, Canzaniello & Hartmann, 2019; Tachizawa & Wong, 2014). Therefore, due to the collaboration of companies within ASSAs, they can leverage their collective bargaining power to improve the sustainability compliance of suppliers. Additionally, the membership is not only available to focal firms but also to suppliers and sub-suppliers (Lechler, Canzaniello & Hartmann, 2019). Thus, the process is not only efficient for focal firms (costs & effort can be shared) but also for suppliers (they are no longer confronted with varying sustainability requirements and there might be an incentive system where they can promote their sustainability performance) (Lechler, Canzaniello & Hartmann, 2019).

In summary, effective supplier assessment involves a careful evaluation and selection processes. It is key for the implementation of sustainability within supply chains. However, this approach alone might not be sufficient, as supplier assessment might be the first step to cascade

sustainability through the supply chain. To generate a long-term impact and to improve the capabilities of suppliers and sub-suppliers, collaboration and development practices are a key factor (Gimenez & Tachizawa, 2012).

2.3.5 The Role of Supplier Development

Supplier development is a strategic and collaborative process where focal firms work closely with their suppliers or sub-suppliers. The goal is to enhance their capabilities, performance, and adherence to sustainability standards and to build a more resilient and responsible supply chain (Grimm, Hofstetter & Sarkis, 2016; Vachon & Klaasen, 2008). Supplier development goes beyond transactional interactions and focuses on the creation of mutually beneficial partnerships that contribute to the success and sustainability of both the buying organization and its suppliers (Grimm, Hofstetter & Sarkis, 2016; Vachon & Klaasen, 2008). To enhance sustainable performance, there needs to be a direct collaboration between supply chain partners. Thereby, focal firms not only foster their supplier's environmental capabilities but also receive more sustainable products or services (Gimenez & Sierra, 2012).

Supplier development involves the investment of resources, allocation of training, and creation of long-term relationships. Thereby, focal firms can improve the overall efficiency, quality, and sustainability of the suppliers/sub-suppliers and thus the supply chain. Supplier development can be separated into three different categories (Bai & Sarkis, 2010; Fu, Zhu & Sarkis, 2012; Trapp & Sarkis, 2016):

Category	Explanation
Knowledge Transfer and Communication	The focuse is on elevating suppliers' understanding and capabilities in sustainable practices. It includes training suppliers on eco-design and sustainable product development, providing technical expertise, setting sustainable performance targets, or fostering joint problem-solving.
Investment and Resource Transfer	The emphasis is on supporting suppliers financially and through other resources. Practices might include transferring employees with expertise in sustainability to suppliers, rewarding suppliers for sustainable performance, and financing capital expenditures of suppliers.
Management and Organizational Practices	Targets the integration of sustainability into the strategic and operational frameworks of suppliers. It might involve requiring and aiding suppliers to obtain certification (e.g., ISO 14000) or cultivating a commitment among top management toward greening the supply chain.

Table 5: Overview Supplier Development

Specific supplier development and collaboration processes include (Bai & Sarkis, 2010; Fu, Zhu & Sarkis, 2012; Trapp & Sarkis, 2016):

Category	Explanation
Training	Enhancement of suppliers' capabilities through workshops, seminars, and on-site/online training sessions to improve their understanding and implementation of sustainable practices. This process not only facilitates a direct transfer of valuable insights and practices but also fosters a collaborative environment where suppliers are equipped with the necessary tools and knowledge to improve their operations.
Resource Transfer	Allocation of financial assistance, technology, or equipment to suppliers to help them upgrade their processes and adopt sustainable practices more effectively.
Joint Development Initiatives	Collaborating on projects to co-create products or processes that are sustainable to leverage the strengths and expertise of both parties.
Information Sharing	Exchange of sustainability-related data, standards, and best practices between the focal firm and suppliers to ensure alignment and foster continuous improvement.
Supplier Recognition Programs	Acknowledgment and reward of suppliers for performance in sustainability (e.g., through preferential business terms) to motivate them and others to implement sustainable practices.

Table 6: Supplier Development Practices

The collaboration between supply chain members can lead to a higher level of sub-supplier compliance with sustainability criteria. Thus, if focal firms share knowledge and resources, they can not only increase the sustainability capabilities of suppliers/sub-suppliers but also the overall sustainability level of their supply chain (Grimm, Hofstetter & Sarkis, 2016). Due to its size, however, it is not possible to manage and develop the entire supply chain to the same extent. Therefore, assessment practices are used to identify the suppliers/sub-suppliers with the highest associated risk/potential for further development (Grimm, Hofstetter & Sarkis, 2016). However, choosing the appropriate supplier development practice is complex due to scarce quantitative data, the unique context of the organization, the diverse backgrounds of suppliers, the complexity, and the required resources. Nonetheless, by combining assessment and collaboration practices firms can achieve synergies in the adoption of sustainable practices (Awasthi & Kannan, 2016; Busse et al., 2016).

2.4 Sustainable Purchasing: Focus Automotive Industry

The automotive industry is one of the largest and most influential industries. This signifies its importance for the pursuit of sustainability and the management of multi-tiered supply chains. Therefore, automotive companies have a strong impact on social and environmental sustainability. The practices and strategies adopted are not only important for the direct impact of the industry but also due to their indirect influence. Both successful and unsuccessful strategies can reshape how other industries approach the topic of sustainability in their supply chain (Mathivathanan, Kannan & Haq, 2018). In numbers, a total of 61,2 million cars were produced in 2022 which generated a global revenue of 2,56 trillion U.S. dollars. Most cars were produced in developed countries by German, Japanese, and US car manufacturers (Statista,

2023). There are significant changes due to consumer pressure, government regulations, and other stakeholder demands. Therefore, automotive companies are forced to consider their environmental and social impacts in addition to economic viability. (Helmers & Marx, 2012).

In the automotive industry, purchased materials usually account for 60-80% of total manufacturing costs (Koplin, Seuring & Mesterharm, 2007). The supply chain is typically a complex, global, multi-tiered network that consists of companies that are geographically dispersed across various regions. In addition, the automotive industry is influenced by intense competition, and growing stakeholder pressures in terms of sustainability sustainability (Siems, Land & Seuring, 2021). Therefore, the management of relationships between carmakers and suppliers/ sub-suppliers has evolved. Initially, they were characterized by short-term contracts and arms-length relationships. However, the industry has moved towards closer and more cooperative supplier-OEM relationships. Strong partnerships and incentive systems have become integral to the implementation of sustainability (Geffen & Rothenberg, 2000). For example, in Japan´s automotive industry, the close manufacturer–supplier relationship became a key success factor. They foster lower development costs and increased quality. Furthermore, the industry exhibited a shift from standards and certifications to more proactive strategies. This can range from monitoring practices to joint development and knowledge management. However, the efforts are often concentrated on individual companies and certain first-tier suppliers rather than lower-tier suppliers (Siems, Land & Seuring, 2021).

2.5 Management Theory

The “Resource-Based Theory (RBT)” emphasizes the importance of firm-specific resources/capabilities to create a sustainable competitive advantage (Barney, 1991). The “Dynamic Capability Theory (DCT)” focuses on a firm's ability to adapt/reconfigure its resources in response to environmental changes (Teece, Pisano & Shuen, 1997). Hence, the DCT focuses on a firm’s ability to (1) solve problems, (2) sense opportunities/threats, (3) make timely and market-oriented decisions, and (4) reconfigure resources to adapt to changing environments (Barreto, 2010). Thus, the ability of focal firms to manage their suppliers and sub-suppliers is closely linked to dynamic capabilities and resources (Siems, Land & Seuring, 2021; Beske, Land, & Seuring, 2014).

Firms are facing increased pressures to integrate sustainability into their supply chains. Dynamic capabilities in the context of SSCM can not only result in better sustainability performance of the supply chain, but also allow firms to navigate the complexity of their supply chain (Beske, Land, & Seuring, 2014). Generally, the earlier firms integrate sustainability in supplier and sub-supplier management, the greater the accumulation of sustainability-related capabilities relative to their competitors (Reuter et al., 2010). Although collaboration with external partners is important, competitive advantage cannot be achieved if organizational management skills, processes, and structures do not support sustainability initiatives (Seifert, 2015). In the realm of dynamic capabilities and sustainable (sub-)supplier management, there is a shift from standards/certifications to proactive strategies, and from monitoring to joint development and knowledge practices (Siems, Land & Seuring, 2021).

2.6 Research Gap

There is a significant research gap in the context of sustainable purchasing in multi-tiered supply chains. The focus of the existing literature is mainly on the adopted strategies and practices in direct supplier management. However, there is limited research regarding the adoption level and the employed sub-supplier management strategies in the automotive industry. In the realm of sustainability and the TBL, most research is focused on the environmental dimension and green supply chains. Therefore, the social component is often overlooked and there is limited research that compares the adoption of both social and environmental criteria in sub-supplier management.

This empirical research aims to close the research gap in the context of sub-supplier management and sustainability. Therefore, there will be a particular focus on the integration of both social and environmental sustainability perspectives in multi-tiered automotive supply chains. This results in the following research question:

“How can automotive companies influence the adoption of sustainability practices amongst sub-suppliers in multi-tiered supply chains?

3. Methodology

This chapter outlines the methodology adopted to address the research question: "How can automotive companies influence the adoption of sustainability practices among their sub-suppliers in the multi-tiered supply chain?". It details the research design, the data collection, and the data analysis.

3.1 Research Design

To address the research question and the identified academic gap, key factors that influence sustainable sub-supplier management were extracted from a comprehensive review of existing research and academic articles that were published in leading journals focused on supply chain management, purchasing, supplier and sub-supplier management, and sustainability. Subsequently, industry experts from various levels of the automotive supply chain validated these factors in interviews. This approach facilitated the utilization of their expertise and professional insights to close the identified research gap.

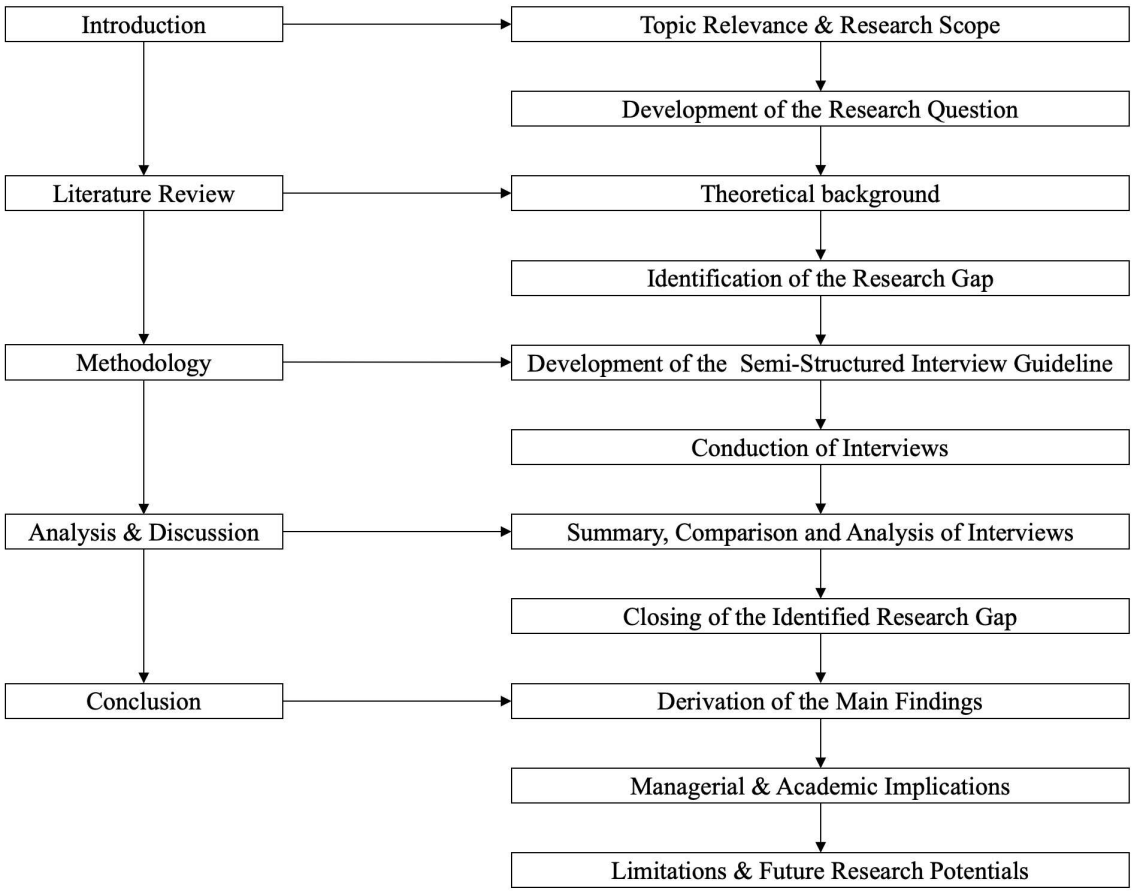

Figure 1: Research Design

Due to the complexity, depth, and novelty of the research question, a qualitative research methodology was chosen. It can shed light on the nuances and contexts surrounding the studied topic. The methodology is suitable due to its ability to explore complex phenomena (Bell, Bryman & Harley, 2018). By focusing on the "how" and "why" questions allowed one to capture an individual's experiences, perceptions, and behaviors, which quantitative methods might not fully address (Baxter & Jack, 2008). Overall, it facilitated the collection of detailed and comprehensive descriptions of practices and strategies within their actual contexts (Baxter & Jack, 2008; Queirós, Faria, & Almeida, 2017).

Hence, expert interviews were selected as the primary data collection method due to their effectiveness in obtaining context-specific insights from individuals within the research area (Bell, Bryman, and Harley, 2018). In addition, semi-structured interviews allow a flexible yet guided conversation. It enables researchers to delve deeper into specific topics while maintaining the structure necessary to address the research objectives. It facilitated a rich and nuanced data collection thus making it optimal to explore complex phenomena within organizational settings (Cachia & Millward, 2011; Edwards & Holland, 2013).

The qualitative approach and in this context semi-structured interviews were particularly relevant to explore the complex research question, as the dynamics between different tiers require a detailed examination and in-depth understanding of how automotive companies influence their sub-suppliers towards sustainability.

3.2 Data Collection

For this research, both primary and secondary data were gathered. The primary data collection involved conducting semi-structured interviews with automotive industry professionals from various supply chain tiers. The purpose of conducting expert interviews was to gather a variety of input throughout the supply chain. The goal was to get a thorough understanding of the strategies used by OEMs but to also understand how these are cascaded through the supply chain. Hence, the interviewees were chosen based on their expertise and position. Therefore, LinkedIn, Xing, and Email were used to contact potential candidates within the personal and professional networks.

Each interview took place online via Microsoft Teams and a time frame of 30 to 60 minutes was set aside to enable an in-depth discussion. The interviews were either conducted in German

or English, depending on the interviewee's preference. Every interview was recorded, transcribed, and anonymized. Overall, a total of 11 interviews were undertaken and participants were divided into three different clusters (OEM-Professionals, First-Tier Professionals, and Lower-Tier Professionals). All experts have a comprehensive professional history that intersects with purchasing/procurement, supply chain management, sub-supplier management, and sustainability. Table 7 provides an overview of the interviewees by assigning them to their respective clusters:

#	Identifier	Position	Date	Time	Length
OEM					
1	OEMa	Senior Specialist Sustainability & Procurement	25.03.24	11:00	40min
2	OEMb	Procurement Manager	02.04.24	19:30	35min
3	OEMc	Project Lead: Sustainability in the Supply	09.04.24	11:00	60min
First Tier					
4	Tier 1a	Forward Sourcing Manager	14.03.24	12:30	30min
5	Tier 1b	Purchasing Manager	19.03.24	14:00	40min
6	Tier 1c	Global Purchasing Director	20.03.24	13:30	30min
7	Tier 1d	Head of Purchasing Germany	02.04.24	15:30	30min
8	Tier 1e	Global Supplier Quality Manager	15.03.24	13:30	25min
Lower Tier					
9	Tier Na	CEO & Head of Finance	18.03.24	17:15	25min
10	Tier Nb	Managing Director	21.03.24	16:00	30min
11	Tier Nc	Business Development Manager	21.03.24	17:00	30min

Table 7: Interview Overview

The interviews were conducted in line with the semi-structured interview process. As the interviewees were separated into three different clusters, three separate interview scripts were used. The questionnaire and a summary of each interview can be found in the Appendix. At the beginning of the interviews, each participant was asked to consent to the recording of the conversation. They were given a brief description of the thesis and how their input will be utilized. The interview participants were asked to introduce themselves and to outline their current position. Overall, the questions were separated into five categories: environmental vs. social criteria, sub-supplier management strategies, the role of the first-tier supplier, supplier assessment & supplier development, and outlook. The questions for first-tier and lower-tier suppliers were framed as the counterpart to the questions for OEMs to understand how these strategies are cascaded through the supply chain.

3.3 Data Analysis

Each interview was transcribed, summarized, and coded. To improve the readability, the interview transcripts were refined. Therefore, light editing was used to adapt sentences, correct grammar, and remove irrelevant words. This facilitated the interpretability of the transcribed texts and allowed the creation of the coding table and summaries.

The employed analytical framework was a structured coding methodology. All codes were derived directly from the research data as there were no predefined codes available. Initially, the raw data was segmented into distinct units. This resulted in 16 first-order codes. Following the derivation of the first-order codes, these codes were then synthesized into six second-order codes. Therefore, the first-order codes were clustered into related codes to abstract the data to a higher level of generalization. The table below shows an example of the coding approach in the form of a table (full table see Appendix):

Second-Order Codes	First- Order Codes	Identifier	Tier	Quotation
Sub-Supplier Management Strategies	Delegation	OEMb	OEM	"We are mainly delegating these responsibilities to our Tier-1 suppliers. Nonetheless, we conduct a risk assessment to pinpoint materials, products, suppliers, or locations that require closer oversight. [...] Enforcing sustainability standards on sub-suppliers is typically not our practice, we mandate our Tier-1 suppliers to manage this aspect. We only intervene in the context of risk and mandate our Tier-1 to take a closer look."
	Adaption of Sub-Supplier Strategies	OEMa	OEM	"We are conducting a risk analysis to identify for which materials, components or sub-suppliers we have to enter the supply chain more extensively by managing our sub-suppliers and which we can delegate to our first-tier suppliers."
	Direct Management	OEMa	OEM	"Occasionally we are engaging in "directed buy" where we are sourcing our sub-suppliers ourselves and then mandate our first-tier suppliers to use these chosen suppliers as their suppliers. […] For resources like Lithium, we select the mines ourselves that comply with our sustainability criteria. We then instruct our suppliers to procure exclusively from these sources."
		OEMa	OEM	"Due to the complexity of our supply chain, it is impossible to manage all of our sub-suppliers directly through processes like audits. We have to select the materials, components or sub-supplier that we manage directly strategically."
	Reward & Punishment for Compliane/Non-Compliance	OEMa	OEM	"In the case of Non-Compliance, suppliers and sub-suppliers are blocked. The sustainability requirements serve as a prerequisite and there is a further monetization of sustainability criteria that influence the selection of suppliers, but due to confidentiality reasons, I cannot go more into detail."

Table 8: Coding Example

The coding of the interviews enabled the analysis of the data gathered and discussion in the light of the literature review. Thereby, the strategies employed, and practices could be outlined, explained, and compared across the supply chain tiers. This allowed for academic and managerial suggestions.

4. Analysis

The following chapter contains the analysis of the gathered data from the expert interviews to set the foundation for the discussion and to answer the research question.

4.1 The Integration of Sustainability Criteria in Sub-Supplier Management

The automotive industry is experiencing a shift in which social and environmental criteria are no longer optional but essential prerequisites for the conduction of business.

The integration of social and environmental criteria:

OEMs have begun to enforce sustainability within their supply chain management practices. Suppliers and sub-suppliers are expected to meet all criteria, as non-compliance leads to the exclusion from business opportunities. All interviewees agreed that sustainability encompasses both social and environmental elements and that they cannot be separated. Hence, OEMs mandate their supplier and sub-supplier to adhere to both sustainability dimensions.

> *"Social and environmental criteria are tackled in the same regard and both serve as a prerequisite for doing business with us. If they are not confirmed, suppliers are blocked." – OEMa*

To qualify as a supplier for OEMs and first-tier suppliers, there are certain minimum social and environmental criteria that need to be fulfilled and proven. Although most sustainability requirements and terms are similar across OEMs and supply chain tiers, occasionally there are product or project specific requirements. However, these are typically limited to the environmental component, as the social criteria are seen as fixed prerequisites. The environmental criteria can be adapted based on project requirements (e.g., recycling quotas).

Communication of sustainability criteria:

Sustainability requirements within the automotive industry are typically communicated through codes of conduct and with the sales department of the respective supplier. As the purchasing department is rarely involved in this process, it is informed by the sales department. According to the interviewee Tier 1d, this is even a desired process, as regular communication between the OEM and the purchasing department might negatively affect the first-tier supplier due to unintended disclosed information. However, both OEMs and first-tier suppliers acknowledged that in some instances, the purchasing department is also directly in contact with OEMs. Nonetheless, first-tier suppliers are mandated to pass sustainability criteria down the supply chain and to provide the necessary evidence. A similar process is adopted by first-tier suppliers.

Consequently, lower-tier suppliers predominantly interact with their immediate customers (first-tier suppliers).

Comparison between traditional and sustainability factors:
Traditional procurement considerations like costs, quality, or logistics strongly influence purchasing decisions. All interviewees acknowledged the importance of the traditional factors for competitiveness and financial and operational performance. However, sustainability has evolved from a desirable attribute to a fundamental requirement. Suppliers must now meet established sustainability standards as a baseline to qualify as a supplier. Moreover, some interviewees stated that sustainability criteria are starting to get monetized.

> *"Traditional factors are the deciding factor, but we have now gained a certain flexibility, to allows us to place an order based on sustainability if the price falls within an acceptable range. [...] The key determinant is the CO2 emission per procured material across the supply chain" - OEMb*

Suppliers who satisfy certain sustainability benchmarks may be favored if the costs are justifiable. Thereby, the environmental component (e.g., CO2 emissions) emerges as the key indicator. Nonetheless, there is a perception among lower-tier suppliers that traditional factors still prevail, and they do not anticipate any changes in that regard. They view these criteria as prerequisites that are imposed by OEMs and Tier 1 suppliers and they have the impression that going beyond them does not provide any direct business benefits.

Differences in sustainability criteria across the supply chain tiers:
The implementation of sustainability requirements varies across the supply chain. OEMs and first-tier suppliers employ similar strategies, as they mandate their suppliers to adhere to predefined sustainability criteria. Due to the dominant position of OEMs, suppliers are forced to accept these requirements, upload the necessary evidence and they have to apply them in their supplier management.

> *"There is one simple rule in the automotive industry, the OEM is the king and if he wants something, we must follow." - Tier 1e*

In contrast, lower-tier suppliers do not enforce similar sustainability mandates. They depend on having trustful and long-term relationships with suppliers that are often located nearby, operate in the same industry, and serve similar clients. As a result, they do not seek formal proof of compliance but rather rely on the goodwill of their suppliers.

Implementation problems regarding OEMs sustainability requirements:

The implementation of sustainability might be influenced by operational difficulties and market constraints. For instance, some OEMs require a certain percentage of materials used in production to be recycled. However, there is a limited availability of recycled materials in the market, and they are typically associated with a higher price point. According to Tier 1a and Tier 1c, OEMs are reluctant to bear the higher costs. In addition, traditional purchasing factors often remain the primary criteria. Therefore, suppliers are forced to procure from low-cost countries to maintain competitive pricing. This might result in lower quality and sustainability standards.

> *"Sometimes Tier 1 suppliers are buying low-cost tools from China, that are then due to low quality brought to us for improvements. Mostly these tools are produced with low quality and even with materials that are forbidden in Europe." – Tier Na*

Moreover, when projects are assigned, sourcing decisions need to be made within a short timeframe to meet the project schedule. This limits the ability for thorough sustainability evaluations beyond the use of certifications and signed codes of conduct.

The extent of supply chain mapping:

To achieve transparency, OEMs are trying to map their supply chain to the n-tier level, especially for critical materials and products. When OEMs approve the products of suppliers, they typically require documents that allow the tracking of products and ensure that the required sustainability standards are met. Due to their power position, OEMs can demand the disclosure of sub-suppliers and first-tier suppliers typically adhere to that.

> *"Our supply chain is quite well mapped. This is not only the case for first-tier suppliers, but also for lower-tier suppliers, especially in the case of critical materials or product." – OEMa*

However, all interviewees acknowledged, that due to the complexity of the supply chain and resource constraints, full transparency is impossible. Therefore, OEMs are trying to implement and leverage new technologies such as AI, barcode scanning, and RFID chips.

Social and environmental challenges at the sub-supplier level:

All interviewees concurred that the primary challenge in sub-supplier management is the complexity of the supply chain. For instance, OEMc noted that they deal with 14.000 direct suppliers from over 60 countries and that their production processes can span over more than ten tiers. Hence, due to resource limitations, it is impossible to oversee the entire supply chain.

Even though all interviewed OEMs and first-tier suppliers have dedicated teams to manage the sustainability efforts, these remain insufficient to fully manage the supply chain.

> *"We do not have the resources to directly control and support every member of our supply chain. We must choose these processes strategically." – Tier 1b*

Moreover, it is difficult to quantify sustainability criteria, as there are no universal standards. For instance, the calculation of a product's CO2 impact can vary significantly depending on the used method. Furthermore, sustainability regulations are still evolving, they can differ regionally, and they can contradict each other. Industry changes (e.g., E-Mobility) are also altering power dynamics as some critical suppliers gain significant leverage over OEMs.

4.2 Sub-Supplier Management Strategies

Companies use a blend of various strategies to manage their sub-suppliers within the context of sustainability. Consequently, there is no universal sub-supplier management approach. Overall, OEMs can either delegate the responsibility to first-tier suppliers or they can choose to engage directly.

Delegation:

In the context of sustainability and sub-supplier management, the interviewed OEMs have primarily adopted the strategy of delegation. Thus, OEMs communicate their sustainability requirements primarily to first-tier suppliers and mandate them to enforce these requirements downstream. They then periodically control and track the compliance of first-tier suppliers through assessments, but they only intervene under certain circumstances.

> *"We are mainly delegating these responsibilities to our Tier-1 suppliers. [...] Enforcing sustainability standards on sub-suppliers is typically not our practice, we mandate our Tier-1 suppliers to manage this aspect. We only intervene in the context of risk." - OEMb*

To monitor and track adherence, OEMs utilize specialized supplier platforms where the codes of conduct and additional requirements are distributed. Suppliers are obligated to sign them, and they must prove their compliance by uploading several documents, such as non-financial reports, self-assessments, certifications, and other sustainability-related documents. These are integral to the supplier qualification and selection process and must be updated periodically (e.g., certifications on a yearly basis). They are reviewed regularly for compliance and any discrepancies or non-compliance result in immediate actions. In that case, the purchasing department must immediately resolve the identified issues, as otherwise the supplier is blocked

until the matter is resolved. Additionally, OEMs have instituted dedicated sustainability teams that are responsible for the monitoring, and management of all supplier activities, including assessment and development practices.

> *"We are communicating our requirements mainly through our code of conduct. We mandate our suppliers to enforce them in their supply chain and to provide all the necessary proof within the supplier portal." - OEMc*

The strategy of delegation is acknowledged by both first-tier and lower-tier suppliers. They indicate that OEMs typically do not engage directly if they meet the OEMs sustainability criteria. OEMs rather mandate first-tier suppliers to push the sustainability requirements downstream. Therefore, lower-tier suppliers are mainly in contact with their direct customers.

> *"The OEM is not actively managing our suppliers. He is delegating this 100% to us by giving us the terms that we and our suppliers must adhere to. He does not interfere in how we implement this in our supply chain." – Tier 1c*

To synthesize, OEMs define sustainability standards and delegate the responsibility of upholding them to their first-tier suppliers. Subsequently, first-tier suppliers are mandated to ensure that their suppliers adhere to these standards.

The adaption of sub-supplier management strategies:
Even though OEMs mainly delegate the management of sustainability and sub-supplier management to first-tier suppliers, they may decide to engage directly under certain circumstances. Depending on the risk or criticality, OEMs adjust their approach accordingly. They utilize a risk matrix that accounts for product type, supplier, or origin, and dictates the sustainability requirements that suppliers must adhere to. Based on the cluster within the risk matrix, a tailored response from OEMs is triggered. This can range from direct management to the mandate of further evidence.

> *"We are also conducting risk assessments based on the product/resource profile, but also based on the country of origin, legislative differences, or corruption KPIs. Each country or product/resource has an individual risk profile that determines the required proves, requirements or additional actions." - OEMb*

OEMs not only adjust their strategies based on risk but also in reaction to emerging problems within the supply chain. Opposed to lower-tier suppliers, interviewees from both OEMs and first-tier suppliers indicate the integration of whistleblower programs that allow any individual to report sustainability violations. Subsequently, all incidents are investigated by a dedicated team and if necessary appropriate actions are carried out.

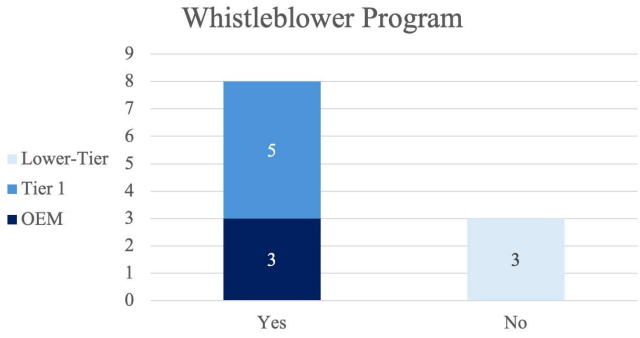

Figure 2: Overview Whistleblower Program

Additionally, one interviewee stressed the role of technological advancements. For instance, OEMc implemented an AI system that monitors online mentions of suppliers and specific keywords and flags potential issues for proactive assessments and mitigation strategies.

> *"On the reactive side, we operate a Whistleblower Program, where we investigate any reports and if necessary, take appropriate actions. On the proactive side, we use an AI system, which is trained to detect potential sustainability violations by using supplier locations, production sites, and specific keywords. It conducts a comprehensive scan of the internet and media outlets for any breaches of our code of conduct, such as strikes, fires, or accidents." - OEMc*

Direct management:

OEMs cannot manage every sub-supplier directly, therefore, they select them carefully. Direct management can entail various assessment and development practices. OEMs contractually reserve the right that upon request, suppliers are obligated to reveal their supply chain and allow access to their sub-suppliers. Furthermore, OEMs often employ “directed buys”. Thereby, they select sub-suppliers directly and mandate first-tier suppliers to only procure from these suppliers. This strategy is used to guarantee consistency in products, as OEMs often source the same product from different suppliers. In addition, it is used for critical products that are susceptible to risk like Lithium. Moreover, they can benefit from cheaper prices due to their market power and purchased quantities. This is acknowledged by Tier 1 suppliers as Tier 1d stated within his purchasing responsibilities, around 50% of the purchasing volumes are directed buys.

> *"Occasionally we are engaging in ´directed buys´ where we are sourcing our sub-suppliers ourselves and then mandate our first-tier suppliers to use these chosen suppliers as their suppliers.” - OEMa*

The OEMs interviewed expressed that the goal of direct sub-supplier management is to go beyond compliance and monitoring and to strive for empowerment via training, education, and collaborative dialogues. Although such proactive initiatives tend to be infrequent.

The role of first-tier suppliers:
As previously shown, OEMs primarily communicate their sustainability requirements with first-tier suppliers. They mandate them to cascade the predefined sustainability requirements through the supply chain. Thus, the OEMs interviewed agreed that first-tier suppliers are seen as integral to their sustainability initiatives. Due to the complexity of the supply chain resource constraints, it is not viable for OEMs to manage the entire supply chain.

> *"First-Tier suppliers are crucial for our sustainability processes, as we cannot and don´t want to manage the whole supply chain." – OEMc*

First-tier suppliers typically adopt similar sustainability and supplier management practices as OEMs. They establish codes of conduct that are largely in line with those of OEMs. Similar to OEMs, they are typically enforced through supplier platforms where evidence of compliance must be submitted. Moreover, they also implemented dedicated teams for sustainable supplier management, and whistle-blower programs. For critical or high-risk items, they may take a more direct management approach, but this is not as sophisticated as in OEMs operations. While some first-tier suppliers adapt their requirements and strategies based on risk (Tier 1b, Tier 1d), some utilize a universal strategy regardless of risk (Tier 1a, Tier 1c, Tier 1e).

First-tier suppliers generally do not collaborate with OEMs beyond the adoption of sustainability requirements. Therefore, collaboration is minimal in the areas of supplier assessment and development. Supplier assessments are typically carried out only when mandated by OEMs or for internal motivations. Furthermore, the interviewed first-tier suppliers often refrain from collaborations in the context of supplier development as they fear that any benefits might be leveraged by OEMs to their advantage.

> *"We don´t collaborate with OEMs in supplier assessment and development. Everything is conducted by our SQM department. [...] Any price advantages through development practices will be imposed back to us by OEMs as they are lowering the prices that they are willing to pay." – Tier 1d*

As there is limited collaboration, OEMs offer optional sustainability trainings for the purchasing department of first-tier suppliers. However, while some interviewees mentioned that

they are aware of those, or were part of such training, other first-tier interviewees stated, that they are not aware of any sustainability training provided by OEMs.

> *"We once received a two-day sustainability training program from an OEM." – Tier 1e*
> *"We never received any training from OEMs in the realm of sustainability." – Tier 1d*

The role of lower-tier suppliers:

As OEMs primarily rely on first-tier suppliers, lower-tier suppliers have limited interactions with OEMs. Thus, all lower-tier suppliers interviewed indicated that they are rarely in direct contact with OEMs. They perceive sustainability criteria as a fundamental condition for the qualification as a supplier. Yet, they saw no significant advantage in exceeding these basic expectations. Their commitment to sustainability was largely driven by a sense of responsibility and reinforced by external incentives like state subsidies, rather than by industry pressures. They perceived the current system to be designed to push the responsibility down the supply chain without genuine concern for the execution of these sustainability practices. If they agree and implemented all requirements, OEMs and first-tier suppliers did not engage directly.

Even though the lower-tier suppliers interviewed perceived sustainability as important, they acknowledged that it is not their focus, as they often only source from long-term, local, and well-known suppliers who are presumed to follow industry norms. Therefore, as opposed to OEMs and first-tier suppliers, there is no strict enforcement of sustainability mandates for suppliers. They rely on trust, which is built on industry regulations and long-term business relationships. Hence, there are no codes of conduct in place for suppliers and sustainability requirements are only passed on if they are specifically demanded by clients.

> *"We internally have a code of conduct, but we are not giving and mandating this to our suppliers. Our suppliers are all in the same industry and we share similar clients. Thus, we are not mandating certain certifications and signed codes of conduct. We rather rely on the fact that they are all in the automotive industry and subject to the same laws and requirements than us." – Tier Nc*

Moreover, lower-tier suppliers are indifferent about who pushes sustainability practices, but generally, their interactions are with immediate clients rather than OEMs. However, due to the considerable purchasing power wielded by both OEMs and first-tier suppliers, they find themselves with little option but to comply.

4.3 Supplier Assessment

In the realm of sub-supplier management and sustainability, the assessment of suppliers is crucial. Certifications act as tangible evidence and audits facilitate a more detailed examination as they help to identify and prevent potential violations.

The role of certifications:

Certifications serve as tangible evidence for a supplier's compliance with sustainability criteria. Therefore, to qualify as a supplier, certain certifications are required by both, OEMs and first-tier suppliers, and they must be submitted through designated web portals. All interviewed OEMs and first-tier suppliers mandate their suppliers to obtain the ISO 14001 certification. Even though all OEMs require the ISO 45001 certification from their direct supplier, only one first-tier supplier (Tier 1b) established this requirement for its suppliers. Nevertheless, OEMs demand that their direct suppliers enforce similar requirements within their supply networks.

> *"We rely on certifications such as ISO 14001 which is a prerequisite to qualify as a supplier. These certifications are demanded from our direct suppliers, and we expect them to ensure that their lower-tier suppliers adhere to similar standards." – OEMb*

Figure 3: Overview Certifications

In addition, both OEMs and first-tier suppliers engage with rating agencies to evaluate the sustainability performance of suppliers. The use of ECOVADIS or similar scores is common among the OEMs and first-tier suppliers interviewed, as only one Tier 1 supplier was not using such scores. However, they only require their suppliers to achieve a minimum score and they acknowledged they do not place a significant emphasis on the scores beyond the required minimum. While ECOVADIS scores are part of OEMs' evaluation criteria, OEMc has introduced an obligatory internal sustainability rating system. Suppliers are mandated to provide thorough documentation on various sustainability metrics, such as CO2 emissions per product. Based on these, an internal team calculates sustainability scores that must reach a certain threshold score.

> *"We implemented a mandatory sustainability rating for each direct supplier. We have a third-party supplier portal provider, where suppliers are required to submit comprehensive documentation to prove their compliance through certifications, training records, sustainability reports, or self-assessment questionnaires. We have set minimum benchmarks for sustainability metrics." - OEMc*

Yet, the requirement for certifications halts at a certain point in the supply chain. Although all surveyed lower-tier suppliers possess the ISO 14001 certification (but not the ISO 45001 certification), they do not impose this requirement on their suppliers. They perceived the process of obtaining certifications as an obligatory and burdensome process that they only undertake due to external mandates. Moreover, the lower-tier suppliers interviewed stated that they thoroughly prepared for these audits.

> *"We are only obtaining these certifications because we must. For us, it is unnecessary work, a lengthy and costly process that is not viable for us. In the end, many resources are wasted for the preparation of the yearly audits." – Tier Na*

OEMs recognized that certifications alone did not constitute a robust sustainability strategy and that additional oversight, and strategies are necessary.

The role of audits:

Besides certifications and other proactive measures, audits play an important role to verify compliance and address potential risks. OEMs perform audits at the sub-supplier level based on risks, detected violations, or whistleblower programs. OEMs recognized that certifications can be acquired more easily in certain regions and that companies can prepare for scheduled audits. Therefore, they occasionally engage in sub-supplier audits. These are either mandated to direct suppliers or conducted by internal or third-party audit teams. Even though they delegated most of the responsibility to first-tier suppliers, OEMs take charge of certain assessments due to criticality or risk. Yet, a dedicated team is checking the reports of all delegated audits to ensure conformity.

> *"Based on violations, risk, or criticality, we are also engaging in audits at the sub-supplier level. They are either conducted by us or an independent third party. Typically, we delegate this responsibility to our first-tier supplier, but some things we need to assess and understand firsthand." - OEMc*

Supplier audits are approached differently among first-tier suppliers. Tier 1b and Tier 1c combined the expertise of both internal and third-party auditors to engage in supplier assessment practices in reaction to risk. However, Tier 1a, Tier 1d, and Tier 1e only utilized internal audit teams and they did not conduct supplier audits based on risk. Instead, they audited based on the criticality of the sourced products and they conducted random checks to ensure

sustainability compliance. Among lower-tier suppliers, the experiences with audits varied. Some indicated that their audit interactions are limited to certification-related reviews and were not initiated by OEMs or first-tier suppliers. Yet, Tier Nb reported that they received audits directly from OEMs. Despite these differences, all lower-tier suppliers experienced minimal direct engagement with OEMs and first-tier suppliers in the context of audits.

> *"We normally only receive audits from the certification bodies, but occasionally we have received direct audits from OEMs." – Tier Nb*

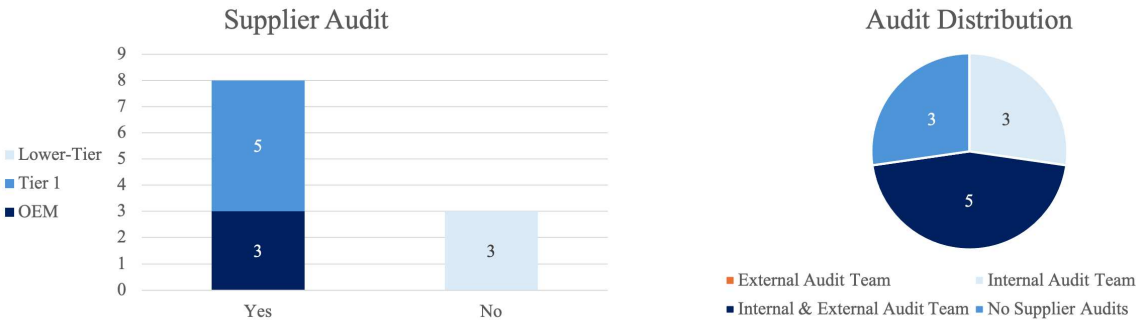

Figure 4: Overview Supplier Audits

Overall, all OEMs and first-tier suppliers engaged in audit practices. While OEMs used a blend of internal and external audit teams, some first-tier suppliers adopted a similar approach, while others exclusively relied on internal teams.

Punishment of non-compliance:

In instances of non-compliance, OEMs and first-tier suppliers adopted similar practices to address sustainability issues. Identified violations are marked for review and the purchasing manager responsible is tasked with handling the problem. If the matter cannot be dealt with in the short term, suppliers are blocked from all business transactions until the situation is resolved. In contrast, at the sub-supplier level, the direct supplier is asked to handle the situation.

> *"We use a "traffic light" light system to evaluate the sustainability performance of our suppliers. A green status indicates full compliance, a yellow requires actions that we then communicate with the supplier for resolution, and a red status results in the blocking of the supplier until the problem is addressed. [...] In cases of violations at the sub-supplier level, we mandate our Tier-1 suppliers to manage the situation." – OEMb*

Even though OEMs and first-tier suppliers adopted similar sustainability and sub-supplier management practices, OEMs were not aware of all violations that occurred within their supply

chain. All interviewed first-tier suppliers reported that sustainability violations within their supply chain were not necessarily communicated to OEMs. They were only passed on if it is directly concerning the OEM. This might happen due to the inability of first-tier suppliers to deliver or if it is a severe violation that directly impacts the OEM.

> *"This is typically handled internally. However, if it directly affects our ability to deliver, the OEM is made aware. In this case, he is either demanding that we are handling it, by dedicating one of our employees to actively manage our supplier on-site or occasionally." – Tier 1d*

4.4 Supplier Development

Supplier development can enhance the long-term sustainability capabilities of suppliers and sub-suppliers. OEMs provided training opportunities to both first-tier and lower-tier suppliers. These trainings are typically offered online within the supplier portal; however, it is not mandatory to participate. In addition, OEMc stated that they have created a comprehensive document which outlines how suppliers can achieve the sustainability requirements and what expectations they must meet.

> *"We offer trainings for our direct suppliers, but they are open for all sub-suppliers. More and more suppliers are interested in these trainings and around 8,000 suppliers or their employees are participating in at least one training a year." OEMc*

Even though some first-tier supplier interviewees have participated in such trainings, the majority were unaware of their existence. A similar situation was reported at the lower-tier level. All Tier N interviewees stated that they are not aware of any trainings, except for some online modules that must be completed by the CEO. However, these are viewed skeptically. They perceived that the purpose of those training was to push the responsibility downstream and to claim that training opportunities have been provided.

> *"I have never received any training, only our CEO. But it is always an online training, and it is only for them to push the responsibility down the supply chain." – Tier Nc*

Supplier development practices may extend beyond training and encompass intensive collaborations. Typically, they are focused on product enhancement or R&D rather than sustainability. Even though sustainability practices are generally assigned to direct suppliers, OEMs occasionally engaged directly for high-risk sustainability areas. For instance, minerals like lithium and cobalt are not only crucial for electric mobility but also subject to sustainability issues. Thus, OEMa and OEMb were actively involved in the supply chain management of those materials. They collaborated with experts and mining companies to share knowledge,

resources, and investments. Thereby, they supported the adoption of sustainable practices and improved adherence to both social and environmental standards.

> *There are some targeted sub-supplier sustainability development programs. They are used mostly in parts of the supply chain where we see a huge criticality. [...] We share knowledge, resources, and investments to support the adoption of more sustainable practices." – OEMa*

At the first-tier level, the degree of supplier sustainability development programs varied. All interviewed Tier 1 suppliers engaged in collaboration or joint development practices in the realm of engineering and R&D. However, this typically included sustainability practices only as a side topic. This was confirmed by lower-tier suppliers, as their involvement in sustainability development programs was mainly limited to trainings. They have participated in collaborative and joint development initiatives for product enhancement and R&D, but not in terms of sustainability. Nevertheless, they expressed a willingness to engage in more substantial collaboration if these were feasible and provided value.

> *"We were never part of any supplier development programs, but we would be open if it makes sense for us and actually provides value." – Tier Na*

Tier1b pointed out that their development programs were mainly limited to guiding suppliers through the necessary documentation of sustainability compliance. Furthermore, all first-tier suppliers agreed that they rarely collaborate with OEMs in the context of supplier development as any improvements or cost advantages might be used by OEMs in their favor. Overall, all OEMs interviewed engaged in sustainable supplier development practices beyond training initiatives. However, at the first-tier level, only Tier 1b and Tier 1c undertook supplier development activities, and only Tier 1b went beyond training practices.

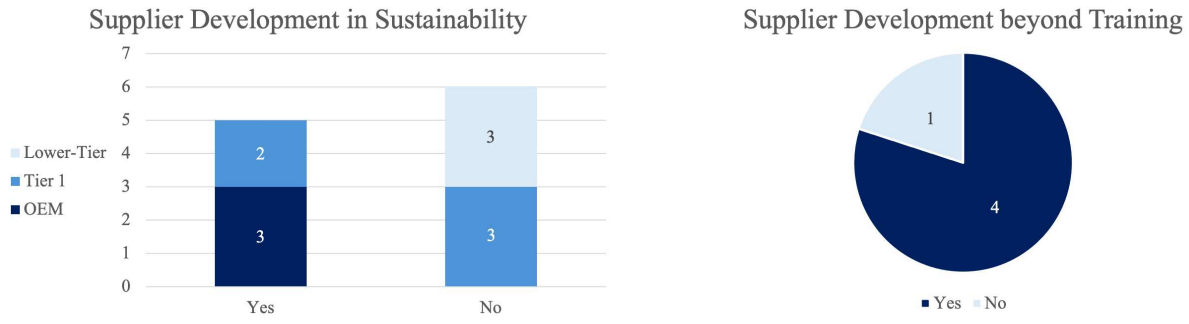

Figure 5: Overview Supplier Development

4.5 Future Outlook

The interviewees expected the importance of sub-supplier management and sustainability to grow. They believed that the key factor will be supply chain transparency, as it allows the ad-hoc origin tracking of purchased materials. They perceived that emerging technologies, like blockchain or AI, will facilitate this transparency. Nevertheless, the OEMs acknowledged that while transparency is essential, it must be accompanied by concrete actions to successfully achieve sustainability. Moreover, they believed that industry alliances could be valuable as they leverage the fact that many OEMs operate in the same regions and source from similar suppliers. Hence, collective actions could result in significant sustainability advancements.

> *"In the future, it will be crucial to create more transparency within the supply chain through technical innovations/ solutions. [...] However, transparency alone is not enough, as actions are required to establish sustainability." – OEMc*

Even though the interviewed sub-suppliers acknowledged that there is not much that OEMs can do differently due to the complexity of the supply chain. They still emphasize that any approach to manage sustainability within supply chains should provide value and should not be an attempt to push the responsibility down the supply chain. They suggested a need for more collaborative and less hierarchical processes that focus on the human component of relationships. This translates to a shift from online training modules towards more cooperative practice and to place trust in certifications like ISO offer impartial and universally accepted benchmarks across the industry.

5. Discussion

The objective of this dissertation was to analyze how automotive companies can influence the adoption of sustainability practices among their sub-suppliers. Therefore, the results from the eleven interviews are put into context with the relevant academic literature.

The supply chain serves an important role within the business operations of companies, as it is connected to all activities involved in managing the flow of goods and services to and from a company (Seuring & Müller, 2008). Within this context, sustainable purchasing describes the management of the acquisition of goods and services to ensure the least impact on society and the environment throughout the product life cycle (Meehan & Bryde, 2011). Automotive supply chains often extend across multiple tiers and are under pressure to adopt sustainable practices. Therefore, for the system to be sustainable, each member of the supply chain must operate in a sustainable manner (Seuring & Müller, 2008).

(1) The Integration of sustainability criteria in sub-supplier management

The TBL consists of three dimensions; economic, social, and environmental which need to be considered for operational sustainability (Elkington & Rowlands, 1999). Within the academic literature, the environmental aspects are thoroughly discussed, while the social dimension is beginning to receive increased attention. Nevertheless, the environmental and social components must be addressed with equal importance (Seuring & Müller, 2008). Therefore, in line with the Dynamic Capability Theory, firms need adequate capacities in both dimensions (Teece, Pisano & Shuen, 1997). In practice, all interview participants agreed that even though both sustainability dimensions are crucial, they mainly serve as a prerequisite for the conduction of business. There is a minimum standard that needs to be fulfilled by every supplier and sub-supplier. While the OEMs interviewed stated that there can be a monetization of sustainability criteria, first-tier, and lower-tier suppliers perceived that the traditional factors prevail and that there is no direct benefit of going beyond the minimum sustainability thresholds. While OEMs are actively incorporating sustainability requirements, they are not necessarily willing to bear the additional costs. OEMs themselves admitted they only choose sustainable options when the traditional factors fall within acceptable limits. This can be explained by the importance of the traditional factors for the operational and financial success of firms. As sustainability is often connected to costs and higher resource demands, firms need a solid financial foundation.

Moreover, within the academic literature both sustainability dimensions are considered essential to achieve sustainability (Elkington & Rowlands, 1999). Yet in practice, the social dimension tends to be more static due to universal requirements across suppliers and projects. Whereas the environmental requirements may be extended for specific products or projects. This can include additional stipulations like the minimum percentage of recycled materials or maximum CO2 emissions. The basis for this is the fact that the environmental component can be more easily quantified and communicated as they are more often linked to tangible outcomes (e.g., energy consumption). However, the implementation of sustainability can be challenging due to operational hurdles and market limitations. Hence, suppliers and sub-suppliers must also have the capabilities to implement these sustainability practices (Grimm, Hofstetter & Sarkis, 2014). For instance, while some OEMs mandate the use of recycled materials in production, there is limited market availability. It complicates compliance and might result in higher costs, which OEMs are often unwilling to bear. This highlights the potential gaps between the intentions of sustainability policies and their implementation. For sustainability goals to be successfully cascaded down the supply chain, the limitations of the market and suppliers need to be considered. In the context of the DCT, this implies that the capabilities of not only OEMs but also lower-tier suppliers are crucial. This requires an open dialogue to find the optimal strategy and mix of sustainability requirements.

Sustainability requirements are typically incorporated in the codes of conduct. These are sets of guidelines and principles that state the expected behavior and ethical standards for individuals or organizations (Mamic, 2005; Awaysheh & Klassen, 2010). They are communicated to the sales department, however, direct interactions between the purchasing units of buyers and suppliers are important to cascade sustainability standards down the supply chain (Villena, 2019). OEM and first-tier interviewees confirmed that sustainability criteria are primarily communicated to the sales department (see Figure 6).

Figure 6: Communication of Sustainability Requirements

The sustainability requirements are communicated through codes of conduct, and specialized supplier portals. Suppliers are required to provide the necessary documentation to demonstrate their compliance (see Figure 7). However, the enforcement of sustainability varies at lower-tier supply chain levels. They do not communicate sustainability requirements beyond product or

project specific stipulations (see Figure 7). They depend on having trustful and long-term relationships and thus they do not seek any proof of compliance. This can be attributed to the fact that lower-tier suppliers are often smaller corporations that have fewer resources available and lower power levels. As a result, they may lack the capability (according to the DCT) to implement comprehensive sustainability measures. These variations can compromise the effectiveness of sustainability initiatives in lower-tier supply chains.

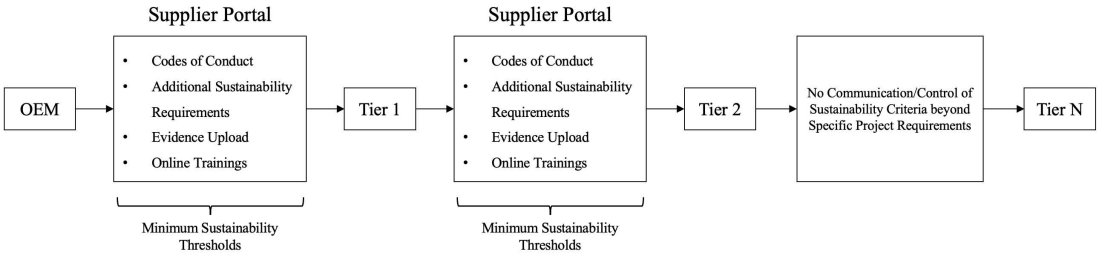

Figure 7: Integration of Sustainability Requirements

Supply chain transparency is crucial for the management of sustainability. Therefore, OEMs are mapping their supply chain up to the n-tier level, especially for critical/risk-prone products (see Figure 8). Due to the complexity of the supply chain, they must rely on the cooperation of direct suppliers for information disclosure (Grimm, Hofstetter & Sarkis, 2014). This is in line with the principal-agent problem, where the supplier (agent) may withhold information from the OEM (principal) (Doney & Cannon, 1997; Grimm, Hofstetter & Sarkis, 2014). Due to the power position of OEMs and first-tier suppliers, they can mandate disclosure. Furthermore, they contractually reserve the right to access the supply chain and they leverage technology to gain access to sourcing data. This allows companies to understand the flow and origin of materials and enables them to monitor the supply chain. Thereby, firms can improve their responsiveness to supply chain violations.

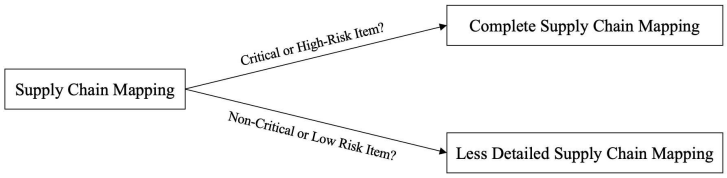

Figure 8: Overview Supply Chain Mapping

(2) Sub-supplier management strategies

Historically sustainability practices have been concentrated on direct suppliers. However, due to shifting regulations and stakeholder pressures, firms need to manage their sub-suppliers. The adopted strategies depend on various factors and resemble those applied to direct suppliers (Grimm, Hofstetter & Sarkis, 2014; Villena & Gioia, 2018). Scholars suggest the most effective sub-supplier management strategies are either direct control or delegation. The objective should not be to manage the entire supply chain, but rather to decide how much of the supply network to control or delegate (Villena & Gioia, 2018; Huang, Song & Swinney, 2022). This became evident during the interviews. Depending on various factors, automotive companies either delegate the management of sub-suppliers to first-tier suppliers/third parties or conduct it themselves. This highlights the decision-making process as companies need to find the most effective sub-supplier management strategies. Thereby, companies can focus on areas where they can exert the most influence or where control is most needed, and delegate the rest.

The practices adopted depend on factors like supply chain complexity, management capabilities of Tier 1 suppliers, risk of non-compliance, public attention, channel power, and overall sustainability objectives (Grimm, Hofstetter & Sarkis, 2016). In line with the academic literature, the interviewees stated that sub-supplier management strategies are adapted based on factors like sustainability risk, product criticality, or detected violations (see Figure 9). OEMs employ a risk matrix that is based on factors like product type, supplier, or origin to determine the sustainability requirements. It dictates a response that can range from direct oversight to the requirement of additional evidence. However, there is no indication that the management capabilities of Tier 1 suppliers, the supply chain complexity, or the sustainability dimension impact the adaption of strategies. Companies also adapt their practices in reaction to sustainability violations. For instance, they utilize whistleblower programs (which are mandatory for certain firm sizes) and technological solutions, like AI systems, to monitor suppliers and scan the internet to identify sustainability issues. This underscores the importance of proactive and reactive management of sub-suppliers to tackle and prevent issues before they become serious problems. Therefore, in line with the DCT, firms adapt and reconfigure their resources in response to environmental changes/challenges to ensure sustainability throughout their supply chain (Barreto, 2010). This allows them to navigate the complexities of sustainability at the sub-supplier level. Furthermore, firms need to develop the ability to effectively detect, solve, and prevent sustainability issues. Hence, they must be able to quickly reconfigure their resource base. This can include the utilization of technological solutions like

AI algorithms or blockchain technology. By identifying sustainability threats and improvement opportunities at early stages, firms can proactively work with their sub-suppliers to adopt sustainable practices. Moreover, scholars highlight there is an allocation of more management resources during the set-up and operating stages and a transition to delegation practices at the sustaining stage (Tachizawa & Wong, 2014; Wilhelm et al., 2016b; Gong et al., 2018). This could not be confirmed, as the sub-supplier management strategies mainly depend on risk, criticality, and detected violations, rather than on the operating stage.

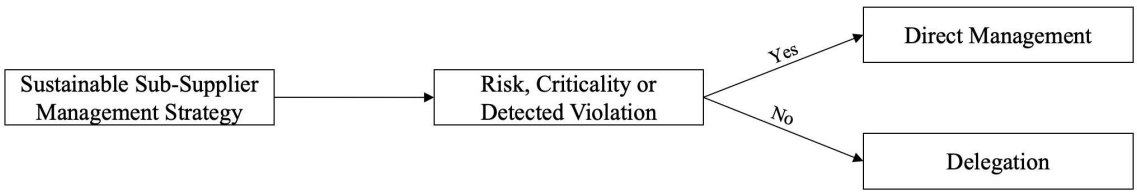

Figure 9: Adaptation of Sub-Supplier Management Strategies

In the context of delegation, the proposed frameworks by Mena et al. (2013), Tachizawa & Wong (2014), and Meinlschmidt et al. (2018) state that focal firms mainly rely on direct suppliers or third parties for the enforcement of sustainability. They utilize delegation methods when confident in the capabilities of direct suppliers (Wilhelm et al., 2016b). In line with the literature, first-tier and lower-tier suppliers agreed that OEMs mainly delegate the enforcement of sustainability to first-tier suppliers and mandate its implementation downstream (see Figure 10). This is monitored by OEMs, as they control in periodic assessments the required documents in the supplier portal. Thereby, a model of delegation is created, where each tier must ensure the next tier complies. It allows OEMs to manage their complex supply chains, but it can lead to the dilution of sustainability standards. As they are passed through multiple tiers, they might be enforced differently. Thus, the system's effectiveness relies on robust initial criteria, the capabilities of suppliers, and strong monitoring processes. Overall, the reliance on delegation methods underscores a reactive rather than a proactive approach in sub-supplier management.

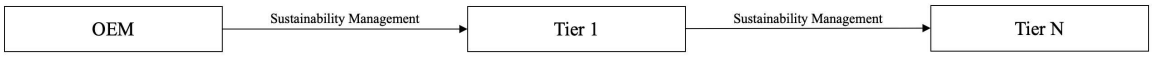

Figure 10: Overview Delegation Strategy

Depending on various factors, focal companies engage in direct management of lower-tier suppliers. This is incorporated in the frameworks of Mena et al. (2013) and Tachizawa & Wong (2014). They suggest when firms experience material criticality, dependency, and risk, they

manage sub-suppliers directly (Gong et al., 2018). Meinlschmidt et al. (2018) extended these frameworks by stating that focal firms manage their sub-suppliers directly for certain products, regions, or events. This is in line with the operational reality (see Figure 11), as the interviewees acknowledged that it is not possible to manage every sub-supplier directly. Hence, they select direct sub-supplier management practices based on risk, criticality, and violations. The decision to opt for direct management practices is hence a mix of proactive and reactive motives. They contractually reserve the right to engage sub-suppliers directly, which they utilize if necessary, for assessment and development purposes. Moreover, OEMs often employ "directed buys" as they mandate first-tier suppliers to purchase only from selected suppliers. They can thus ensure product consistency, manage risks for critical materials like lithium, or capitalize on lower prices due to their market power. Even though OEMs aim to empower suppliers through trainings or collaborative practices, these efforts are rare because they are resource intensive and typically engage first with first-tier suppliers.

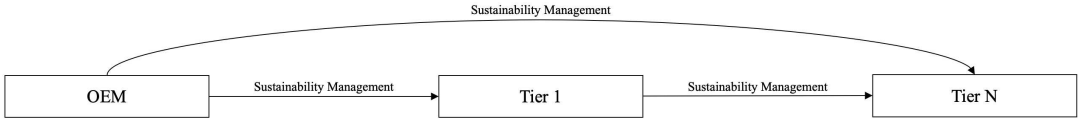

Figure 11: Overview Direct Sub-Supplier Management

First-tier suppliers can be influential, as they sometimes even surpass OEMs in size. In addition, they are subject to the same legal jurisdictions as OEMs (e.g., mandatory non-financial reporting) and to public, media, and NGO attention. Therefore, they incorporate a crucial position within the context of sustainability and sub-supplier management. Thus, first-tier suppliers assume a "Double Agency Role". They act as agents that implement the focal firm's sustainability requirements and cascade them down the supply chain (Wilhelm et al., 2016a). The interviewed Tier 1 suppliers have comparable codes of conduct as OEMs and adopt similar sustainability practices. However, these are often less sophisticated. Moreover, while some first-tier suppliers adapt their strategies based on risk, others apply a one-size-fits-all approach. This depends on the location and type of suppliers as Tier 1a and Tier 1d indicated that they mainly source from European suppliers. Therefore, there is no need for a sophisticated risk approach. This variability might introduce vulnerabilities that could undermine the adoption of sustainability across the supply chain. Despite the importance of Tier 1 suppliers, there is usually no collaboration with OEMs in the context of supplier assessment and development. This is explained by the fact that any improvement might be used by OEMs to their advantage.

This minimal collaboration beyond compliance suggests a lack of trust between OEMs and first-tier suppliers. In addition, it might limit the exchange of best practices which are essential for the advancement of sustainability initiatives.

For sub-suppliers to adopt OEMs' sustainability requirements beyond the legal baseline, they must perceive benefits or have the capabilities to implement these practices (Wilhelm et al., 2016b; Grimm, Hofstetter & Sarkis, 2014). The lower-tier suppliers interviewed had limited interactions with OEMs, and they conceived of no significant advantage in exceeding the basic sustainability requirements. They perceived the current system to be designed to push the responsibility down the supply chain without genuine concern for the execution. They implemented the required sustainability criteria, but as opposed to OEMs and first-tier suppliers, they did not enforce sustainability mandates onto suppliers. This weakens the overall effectiveness of sustainability measures within the supply chain. The limited interactions between OEMs and lower-tier suppliers as well as missing incentives result in different adaptation levels of sustainability practices across the supply chain.

(3) Supplier assessment

Supplier assessment is crucial to ensure compliance with pre-defined sustainability criteria. This is not only important for the initial supplier selection process, but also for monitoring and development practices (Grimm, Hofstetter & Sarkis, 2016; Luthra et al., 2017).

Certifications serve as standardized sustainability benchmarks and companies often rely on them as tangible evidence of the commitment of suppliers to sustainability (Beske, Koplin & Seuring, 2008; Grimm, Hofstetter & Sarkis, 2016). This was confirmed by all interviewees, as certain certifications are required by both OEMs and first-tier suppliers. While environmental certifications (ISO 14001) and scores (ECOVADIS or similar) are required by all OEMs and almost all Tier 1 suppliers, social certifications (ISO 45001) are less used. Even though all OEMs require them, only one first-tier supplier enforces them within the supply chain. This can be explained by the fact that environmental criteria are easier to quantify and communicate. In today's business environment, there is a demand for environmentally sustainable products and practices. Therefore, to meet the expectations of customers and the market, firms must prioritize the environmental component. However, in line with the literature, the interviewees acknowledged some limitations. First, even though the lower-tier suppliers stated that they obtained these certifications, they do not impose those requirements down the supply chain.

Thus, the demand for certifications halts at a certain point within the supply chain. This gap might result in inconsistencies in the adoption of sustainability across the supply chain. Second, OEMs and first-tier suppliers agree that certifications alone do not constitute a robust sustainability strategy. They can be easily obtained in developing countries and companies can prepare extensively. Hence, certifications do not always reflect the true sustainability performance of a supplier. Third, it became evident that automotive companies do not place a significant emphasis on the scores beyond the required minimum. This implies while certifications are necessary for compliance, they may not drive deeper sustainability efforts. In the context of the DCT, firms therefore need to continuously adapt and refine their sustainability practices based on environmental changes and challenges.

Supplier auditing allows firms to assess the adherence of suppliers to predefined sustainability criteria. To evaluate the performance and compliance of suppliers, firms examine their processes, documentation, and management systems (Plambeck & Taylor, 2016; Gimenez & Sierra, 2012). However, they may not be sufficient as suppliers might employ deceptive practices (Huq, Chowdhury & Klassen, 2016; Plambeck & Taylor, 2016). While the OEMs interviewed performed audits at the sub-supplier level based on sustainability risk, product criticality, and detected violations (e.g., whistleblowing program or AI algorithm), the reasons differed for Tier 1 suppliers. Some conduct their audits based on risk, while others only perform them based on the criticality of products or based on whistleblower programs. The chosen strategy depends on the complexity of the supply chain and the associated risk. In instances of low sustainability risk, it might be sufficient to only audit based on violations or criticality. Both OEMs and first-tier suppliers used a mix of internal teams and third parties. However, two first-tier suppliers only utilized internal teams for audit purposes. The main deciding factor is the complexity of the supply chain and the location of suppliers. If the main suppliers are located in the same region, the available resources of internal team were sufficient. The lower-tier suppliers interviewed experienced minimal direct engagement with OEMs and first-tier suppliers in the context of audits, as they were mainly related to certifications. Moreover, as lower-tier suppliers did not cascade sustainability requirements to their suppliers, they did not conduct supplier audits. The differences in the utilization of audit practices across supply chain tiers might undermine the implementation of sustainability.

In instances of non-compliance, firms are instantly trying to resolve the issue. If this is not possible in the short term, suppliers are blocked from all business transactions until the situation

is resolved. Even though, firms within the automotive supply chain adopt similar sustainability and sub-supplier management practices, OEMs are not aware of all violations as they are not necessarily communicated by suppliers. They are only passed on if it directly concerns the OEM. This limits the flow of information and hinders the ability of OEMs to respond.

(4) Supplier development

Supplier development is a process where firms work closely with their suppliers to enhance their capabilities, and adherence to sustainability standards (Grimm, Hofstetter & Sarkis, 2016; Vachon & Klaasen, 2008). It can be separated into knowledge transfer & communication, investment & resource transfer, and management & organizational practices (Bai & Sarkis, 2010; Fu, Zhu & Sarkis, 2012; Trapp & Sarkis, 2016). However, scholars agree that due to the size of the supply chain, it is not possible to manage and develop the entire supply chain (Grimm, Hofstetter & Sarkis, 2016). The interviewees confirmed that supplier development is mainly limited to knowledge transfer. OEMs and first-tier suppliers offer online training modules which are available to all direct and indirect suppliers (but not mandatory). Therefore, some suppliers were unaware of their existence. Generally, trainings were perceived skeptically, as its effectiveness and relevance were doubted. This results in a perceived disconnect between the content of training modules and the practical needs of suppliers. They were only willing to engage in more substantial collaboration if these were practically feasible and provided value.

More intensive collaborations are typically focused on product enhancement or R&D rather than sustainability initiatives. Yet, OEMs occasionally adopted sub-supplier development practices in the context of high-risk products or materials. In these instances, OEMs engage directly with sub-suppliers. They strongly manage, invest, and collaborate with various stakeholders to improve the sustainability level. Even though these initiatives provide a huge sustainability upside, they are limited due to resource constraints. This fosters the implementation of simpler processes like knowledge transfers through training. Thus, closer collaborations are limited to critical, high-risk, and high-value items to guarantee maximal impact. However, in agreement with the DCT, by improving the dynamic capabilities of suppliers and the firms themselves, the sustainability level of the whole supply chain can be improved. This is explained by the ability of firms to adapt, integrate, and reconfigure their resources/capabilities, as they are critical for achieving long-term sustainability goals.

6. Conclusions

This chapter summarizes the results, draws implications for research and practice, describes the limitations of the methodology, and outlines areas for future research.

6.1 Main Findings

The thesis analyses how automotive companies can influence the adoption of sustainability practices among their sub-suppliers in their multi-tiered supply chain. The following main findings can be derived from the analysis to close the identified research gap.

(1) The importance of sustainability: Both sustainability dimensions serve as a prerequisite to qualify as a supplier as there is a minimum threshold for each criterion that needs to be exceeded. The social dimension tends to be more static since the criteria are universal across suppliers and projects. Whereas the environmental requirements may be extended for specific products or project requirements (e.g., maximum CO2 emissions). Even though sustainability criteria can be monetized, the importance of the traditional factors still prevails as they need to fall within acceptable limits. Therefore, lower-tier suppliers do not perceive a significant advantage in exceeding the basic sustainability requirements.

(2) Sub-supplier management strategies: Sustainability criteria are typically integrated into the supplier codes of conduct and communicated through dedicated supplier portals. Suppliers need to accept all requirements and provide tangible evidence for their compliance. In instances of non-compliance, suppliers are blocked from all business transactions until the situation is resolved. OEMs mainly adopt delegation practices, as they require first-tier suppliers to enforce sustainability requirements and cascade them down the supply chain. In terms of direct sub-supplier management, automotive companies, due to resource constraints, adopt a selective approach. They identify suppliers where they can generate the most impact or where control is most needed.

(3) The adaption of strategies: Sub-supplier management strategies are adapted based on factors like sustainability risk, product criticality, or detected violations. OEMs employ a risk matrix that determines sustainability requirements and dictates adequate responses. Moreover, practices are adapted based on detected sustainability violations. In this context, whistleblower

programs and technological solutions like AI systems are utilized to monitor suppliers and scan the internet to identify sustainability issues.

(4) Cascading of sustainability criteria through the supply chain: The adopted sub-supplier management practices result in a model of delegation across the supply chain. Each tier is accountable to ensure that the next tier complies. It allows OEMs to manage their complex supply chains, but it can lead to the dilution of sustainability standards. Thus, effectiveness relies on robust initial criteria, the capabilities of suppliers, and strong monitoring processes across tiers. Furthermore, the implementation of sustainability requirements varies across supply chain tiers. Even though first-tier suppliers generally mirror OEMs' sustainability practices, they are often less sophisticated. In contrast to OEMs and first-tier suppliers, lower-tier suppliers do not communicate sustainability criteria and seek formal proof of compliance.

(5) Sub-supplier management practices: Automotive companies employ direct buys and assessment/development practices. OEMs and first-tier suppliers require certain sustainability scores (e.g., ECOVADIS) and ISO certifications (mainly ISO 14001 and ISO 45001). However, since lower-tier suppliers do not mandate sustainability requirements, the demand for certifications halts at a certain point within the supply chain. As certifications may not always reflect sustainability performance, there is no significant emphasis on the scores beyond the required minimum. Therefore, additional strategies like audits are employed to hold suppliers accountable for their actions. The responsibility to conduct audits is typically delegated to first-tier suppliers, yet OEMs perform audits at the sub-supplier level based on risk, criticality, and detected violations. Supplier development practices are mainly limited to knowledge transfers like online training modules. More intensive collaborations are typically limited to product enhancement or R&D rather than sustainability initiatives. However, OEMs occasionally adopt sub-supplier development practices in the context of high-risk products or materials. Furthermore, first-tier suppliers do not collaborate with OEMs in the context of supplier development since OEMs might use the benefits to their advantage. In addition, OEMs utilize "directed buys" to mandate first-tier suppliers to only purchase from selected suppliers. Thereby, they can ensure product consistency, manage risks for critical materials, and benefit from lower purchasing prices.

6.2 Theoretical and Managerial Implications

(1) Academic implications

Past research has primarily focused on direct supplier relationships and the environmental component of the TBL. The thesis aims to analyze how environmental and social sustainability are integrated into sub-supplier management within the automotive industry.

The research draws upon the TBL framework provided by Elkington & Rowlands (1999) and the sub-supplier management strategies proposed by Mena et al. (2013), Tachizawa & Wong (2014), and Meinlschmidt et al. (2018). Contrary to the literature, the research shows the difference between the environmental and social components. There are minimum thresholds for both dimensions, but the environmental requirements can change depending on the product or project. In line with the literature, automotive companies either delegate or manage their sub-suppliers directly. Sub-supplier management strategies are adapted based on factors like sustainability risk, product criticality, or detected violations. However, there is no indication that the management capabilities of suppliers, the supply chain complexity, or the sustainability dimension impact the adaption of strategies. Moreover, there is no evidence of an allocation of more management resources during the set-up and operating stages and a transition to delegation practices at the sustaining stage. Adding to the academic literature, automotive companies often employ "directed buys" as they mandate suppliers to purchase only from selected suppliers.

Furthermore, the Dynamic Capability Theory is in line with the operational reality as firms need adequate capabilities in both sustainability dimensions. However, for sustainability requirements to be successfully cascaded down the supply chain, the capabilities of not only OEMs but also first and lower-tier suppliers are pivotal. Therefore, firms need to be able to continuously adapt and refine their sustainability practices based on environmental changes and challenges. This allows them to develop the ability to effectively detect, solve, and prevent sustainability issues across the supply chain.

(2) Managerial implications

The thesis shows the significance of sustainability and sub-supplier management. However, there are still obstacles that firms need to address to successfully integrate and manage sustainability within their supply chain.

It became evident that sub-suppliers do not perceive any value in going beyond the minimum sustainability requirements. The motivation to further pursue sustainability is therefore mainly based on intrinsic motivations. Furthermore, lower-tier suppliers believe that the current sustainability practices are rather an operational burden than a source of value. Hence, automotive companies should rethink their practices and further incentivize and monetize the integration of sustainability beyond traditional purchasing factors.

The differences in the adoption levels of sustainability practices across the automotive supply chain tiers limit its implementation. The model of delegation where each tier is accountable to ensure that the next complies results in the dilution of sustainability standards as the communication of these criteria halts at a certain point within the supply chain. Therefore, automotive companies should engage in closer collaboration with their supply chain partners and utilize external stakeholder and industry alliances. Moreover, to foster supply chain transparency, firms should further leverage technological advancements.

6.3 Limitations

Due to the study design and the qualitative approach of data gathering, there are limitations that might impact the interpretability of the results:

(1) Time constraints: The research was conducted within a short time frame which limited the depth and scope. Therefore, the most important factors were prioritized, and some elements had to be excluded.
(2) Complexity: Sustainability and sub-supplier management are subject to market fluctuations, regulation updates, and other stakeholder pressures. Therefore, the topic evolves quickly which can limit the relevance of the findings.
(3) Sample and methodological choice: A qualitative approach was used to address the research question. Even though the methodology provided rich data, there are some limitations. Due to time constraints, only 11 interviews were conducted. The interviewees might have been subject to certain biases, subjectivity, and confidentiality constraints. Therefore, they might not have been aware (or able to disclose) all of the adopted sub-supplier management strategies. This limits the validity and representativeness of the findings. Although the sample size across the automotive supply chain allowed the identification of recurring patterns, there are some limitations. There was a narrow scope per company/tier/geographical location and the

interviews were mainly conducted with high-quality and high-priced European companies within the automotive supply chain. Therefore, the study´s representativeness, depth, and applicability could be enriched by expanding the participant base per company, market segment (high vs. low quality/price), tier, and geographical location.

Despite these limitations, the study offers insights into the topics of sustainability and sub-supplier management. However, the limitations identified reveal potential avenues for future research and improvements.

6.4 Future Research

Due to the novelty of the topic and the presented limitations, there are several opportunities for future research to deepen the understanding of sustainability and sub-supplier management. These areas include:

(1) Technologies like AI are currently reshaping the topic of sustainability and sub-supplier management. Future studies could explore how this impacts the adopted strategies, as well as factors like governance structures, supply chain mapping, risk management, or supplier monitoring.

(2) Firms are starting to monetize sustainability criteria. Therefore, it might be interesting to examine the decision-making and quantification process. How are these factors concretely monetized, how do they compare to traditional factors, how do they impact purchasing decisions and how do they impact the implementation of sustainability across the supply chain?

(3) The scope of this thesis is limited to European high-quality firms within the automotive supply chain. However, by extending the scope to include companies from developing countries and other stakeholders such as policymakers, NGOs, or rating/audit agencies, the understanding of the subject matter could be improved. They could offer a broader range of perspectives and increase the representativeness of the findings. Moreover, by including other industries, it would be possible to derive distinctions and best practices in sustainable sub-supplier management practices across industries.

Bibliography

- Awasthi, A., & Kannan, G. (2016), "Green supplier development program selection using NGT and VIKOR under fuzzy environment", *Computers & Industrial Engineering*, 91, p. 100-108.
- Awaysheh, A., & Klassen, R. D. (2010), "The impact of supply chain structure on the use of supplier socially responsible practices", *International Journal of Operations & Production Management*, 30(12), p. 1246-1268.
- Bai, C., & Sarkis, J. (2010), "Green supplier development: analytical evaluation using rough set theory", *Journal of cleaner production*, 18(12), p. 1200-1210.
- Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of management*, 17(1), 99-120.
- Barreto, I. (2010), "Dynamic capabilities: A review of past research and an agenda for the future", *Journal of Management*, 36(1), 256-280.
- Baxter, P., & Jack, S. (2008), "Qualitative case study methodology: Study design and implementation for novice researchers", *The qualitative report*, 13(4), p. 544-559.
- Bell, E., Bryman, A., & Harley, B. (2022), "Business research methods", *Oxford university press*.
- Beske, P., Koplin, J., & Seuring, S. (2008), "The use of environmental and social standards by German first-tier suppliers of the Volkswagen AG", *Corporate social responsibility and environmental management*, 15(2), p. 63-75.
- Beske, P., Land, A., & Seuring, S. (2014), "Sustainable supply chain management practices and dynamic capabilities in the food industry: A critical analysis of the literature", *International Journal of Production Economics*, 152, 131-143.
- Brundtland Report (1987), "Our Common Future", *World Commission on Environment and Development.*
- Busse, C., Schleper, M. C., Niu, M., & Wagner, S. M. (2016), "Supplier development for sustainability: contextual barriers in global supply chains", *International Journal of Physical Distribution & Logistics Management*, 46(5), p. 442-468.
- Cachia, M., & Millward, L. (2011), "The telephone medium and semi-structured interviews: a complementary fit", *Qualitative Research in Organizations and Management: An International Journal*, 6(3), p. 265-277.
- Carter, C. R. (2000), "Ethical issues in international buyer–supplier relationships: a dyadic examination", *Journal of operations management*, 18(2), p. 191-208.

- Carter, C. R., Kale, R., & Grimm, C. M. (2000), "Environmental purchasing and firm performance: an empirical investigation", *Transportation Research Part E: Logistics and Transportation Review*, 36(3), p. 219-228.
- Crespin-Mazet, F., & Dontenwill, E. (2012), "Sustainable procurement: Building legitimacy in the supply network", *Journal of Purchasing and Supply Management*, 18(4), p. 207-217.
- Doney, P. M., & Cannon, J. P. (1997), "An examination of the nature of trust in buyer–seller relationships", *Journal of Marketing*, 61(2), p. 35-51.
- Ecovadis (2024), Retrieved on 01.02.2024 from: https://ecovadis.com/de/suppliers/
- Edwards, R., & Holland, J. (2013), "What is qualitative interviewing?", *Bloomsbury Academic.*
- Elkington, J. (1997), "The triple bottom line", *Environmental management: Readings and cases*, 2, p. 49-66.
- Elkington, J., & Rowlands, I. H. (1999), "Cannibals with forks: The triple bottom line of 21st century business", *Alternatives Journal*, 25(4), 42.
- European Commission (2022, February 23), "Just and sustainable economy: Commission lays down rules for companies to respect human rights and environment in global value chains", Retrieved on 11.02.2024 from: https://ec.europa.eu/commission/presscorner/detail/en/IP_22_1145
- Fu, X., Zhu, Q., & Sarkis, J. (2012), "Evaluating green supplier development programs at a telecommunications systems provider", *International Journal of Production Economics*, 140(1), p. 357-367.
- Geffen, C. A., & Rothenberg, S. (2000), "Suppliers and environmental innovation: the automotive paint process", *International Journal of Operations & Production Management*, 20(2), p. 166-186.
- Gimenez, C., & Sierra, V. (2013), "Sustainable supply chains: Governance mechanisms to greening suppliers", *Journal of Business Ethics*, 116, p. 189-203.
- Gimenez, C., & Tachizawa, E. M. (2012), "Extending sustainability to suppliers: a systematic literature review", *Supply Chain Management: an international journal*, 17(5), p. 531-543.
- Gong, Y., Jia, F., Brown, S., & Koh, L. (2018), "Supply chain learning of sustainability in multi-tier supply chains: a resource orchestration perspective", *International Journal of Operations & Production Management*, 38(4), p. 1061-1090.

- Govindan, K., Khodaverdi, R., & Jafarian, A. (2013), “A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach”, *Journal of Cleaner Production*, 47, p. 345-354.
- Govindan, K., Shankar, M., & Kannan, D. (2018), “Supplier selection based on corporate social responsibility practices”, *International Journal of Production Economics*, 200, p. 353-379.
- Govindan, K., Shaw, M., & Majumdar, A. (2021), “Social sustainability tensions in multi-tier supply chain: A systematic literature review towards conceptual framework development”, *Journal of cleaner production*, 279.
- Grimm, J. H., Hofstetter, J. S., & Sarkis, J. (2014), “Critical factors for sub-supplier management: A sustainable food supply chains perspective”, *International journal of production economics*, 152, p. 159-173.
- Grimm, J. H., Hofstetter, J. S., & Sarkis, J. (2016), “Exploring sub-suppliers' compliance with corporate sustainability standards”, *Journal of Cleaner Production*, 112, p. 1971-1984.
- Hartmann, J., & Moeller, S. (2014), “Chain liability in multitier supply chains? Responsibility attributions for unsustainable supplier behavior”, *Journal of operations management*, 32(5), p. 281-294.
- Helmers, E., & Marx, P. (2012), “Electric cars: technical characteristics and environmental impacts”, *Environmental Sciences Europe*, 24(1), p1-15.
- Hoejmose, S. U., & Adrien-Kirby, A. J. (2012), “Socially and environmentally responsible procurement: A literature review and future research agenda of a managerial issue in the 21st century”, *Journal of Purchasing and supply management*, 18(4), p. 232-242.
- Huang, L., Song, J. S., & Swinney, R. (2022), “Managing social responsibility in multitier supply chains”, *Manufacturing & Service Operations Management*, 24(6), p. 2843-2862.
- Humphreys, P. K., Wong, Y. K., & Chan, F. T. S. (2003), “Integrating environmental criteria into the supplier selection process”, *Journal of Materials processing technology*, 138(1-3), p. 349-356.
- Huq, F. A., Chowdhury, I. N., & Klassen, R. D. (2016), “Social management capabilities of multinational buying firms and their emerging market suppliers: An exploratory study of the clothing industry”, *Journal of Operations Management*, 46, p. 19-37.

- Islam, M. M., Turki, A., Murad, M. W., & Karim, A. (2017), "Do sustainable procurement practices improve organizational performance?", *Sustainability*, 9(12).
- ISO 14000 (2024), Retrieved on 01.02.2024 from: https://www.iso.org/standards/popular/iso-14000-family
- ISO 45001 (2024), Retrieved on 02.05.2024 from: https://www.iso.org/standard/63787.html
- Jabbour, A. B. L., & Jabbour, C. J. (2009), "Are supplier selection criteria going green? Case studies of companies in Brazil", *Industrial Management & Data Systems*, 109(4), p. 477-495.
- Jamalnia, A., Gong, Y., & Govindan, K. (2023), "Sub-supplier's sustainability management in multi-tier supply chains: A systematic literature review on the contingency variables, and a conceptual framework", *International Journal of Production Economics*, 255.
- Khan, S. A. R., Yu, Z., Umar, M., & Tanveer, M. (2022), "Green capabilities and green purchasing practices: A strategy striving towards sustainable operations", *Business Strategy and the Environment*, 31(4), p. 1719-1729.
- Koplin, J., Seuring, S., & Mesterharm, M. (2007), "Incorporating sustainability into supply management in the automotive industry–the case of the Volkswagen AG", *Journal of cleaner production,* 15(11-12), p. 1053-1062.
- Krause, D. R., Vachon, S., & Klassen, R. D. (2009), "Special topic forum on sustainable supply chain management: Introduction and reflections on the role of purchasing management", *Journal of Supply Chain Management*, 45(4), p. 18-25.
- Lechler, S., Canzaniello, A., & Hartmann, E. (2019), "Assessment sharing intra-industry strategic alliances: Effects on sustainable supplier management within multi-tier supply chains", *International Journal of Production Economics*, 217, p. 64-77.
- Luthra, S., Govindan, K., Kannan, D., Mangla, S. K., & Garg, C. P. (2017), "An integrated framework for sustainable supplier selection and evaluation in supply chains", *Journal of cleaner production*, 140, p. 1686-1698.
- LkSG (2021), "Gesetz über die unternehmerischen Sorgfaltspflichten zur Vermeidung von Menschenrechtsverletzungen in Lieferketten (Lieferkettensorgfaltspflichtengesetz - LkSG)", Retrieved on 10.02.2024 from: https://www.gesetze-im-internet.de/lksg/BJNR295910021.html#BJNR295910021BJNG000101000
- Mamic, I. (2005), "Managing global supply chain: the sports footwear, apparel and retail sectors", *Journal of Business Ethics*, 59, p. 81-100.

- Mathivathanan, D., Kannan, D., & Haq, A. N. (2018), "Sustainable supply chain management practices in Indian automotive industry: A multi-stakeholder view. Resources", *Conservation and Recycling*, 128, p. 284-305.
- Meehan, J., & Bryde, D. (2011), "Sustainable procurement practice", *Business strategy and the environment*, 20(2), p. 94-106.
- Meinlschmidt, J., Schleper, M. C., & Foerstl, K. (2018), "Tackling the sustainability iceberg: a transaction cost economics approach to lower tier sustainability management", *International Journal of Operations & Production Management*, 38(10), p. 1888-1914.
- Mena, C., Humphries, A., & Choi, T. Y. (2013), "Toward a theory of multi-tier supply chain management", *Journal of Supply Chain Management*, 49(2), p. 58-77.
- Menon, R. R., & Ravi, V. (2022), "Using AHP-TOPSIS methodologies in the selection of sustainable suppliers in an electronics supply chain", *Cleaner Materials*, 5.
- Najjar, M., & Yasin, M. M. (2023), "The management of global multi-tier sustainable supply chains: a complexity theory perspective", *International Journal of Production Research*, 61(14), p. 4853-4870.
- Plambeck, E. L., & Taylor, T. A. (2016), "Supplier evasion of a buyer's audit: Implications for motivating supplier social and environmental responsibility", *Manufacturing & Service Operations Management*, 18(2), p. 184-197.
- Queirós, A., Faria, D., & Almeida, F. (2017), "Strengths and limitations of qualitative and quantitative research methods", *European journal of education studies*.
- Rafi, T. (2021, February 10), "Why corporate strategies should be focused on sustainability", Forbes, Retrieved on 11.02.2024 from: https://www.forbes.com/sites/forbesbusinesscouncil/2021/02/10/why-corporate-strategies-should-be-focused-on-sustainability/?sh=280b39a87e9fh
- Reuter, C., Foerstl, K. A. I., Hartmann, E. V. I., & Blome, C. (2010), "Sustainable global supplier management: the role of dynamic capabilities in achieving competitive advantage", *Journal of Supply Chain Management*, 46(2), 45-63.
- SA8000 (2024), Retrieved on 01.02.2024 from: https://sa-intl.org/programs/sa8000/
- Sarkis, J., & Dhavale, D. G. (2015), "Supplier selection for sustainable operations: A triple-bottom-line approach using a Bayesian framework", *International Journal of Production Economics*, 166, p. 177-191.

- Seifert, R. (2015), “Dynamic capabilities in sustainable supply chain management: A theoretical framework”, *In Supply Chain Forum: An International Journal* (Vol. 16, No. 4, pp. 2-15).
- Seuring, S., & Müller, M. (2008), “From a literature review to a conceptual framework for sustainable supply chain management”, *Journal of cleaner production*, 16(15), p. 1699-1710.
- Shen, L., Olfat, L., Govindan, K., Khodaverdi, R., & Diabat, A. (2013), “A fuzzy multi criteria approach for evaluating green supplier's performance in green supply chain with linguistic preferences”, *Resources, Conservation and Recycling*, 74, p. 170-179.
- Siems, E., Land, A., & Seuring, S. (2021), “Dynamic capabilities in sustainable supply chain management: an inter-temporal comparison of the food and automotive industries”, *International Journal of Production Economics*, 236.
- Silva, M. E., & Ruel, S. (2022), “Inclusive purchasing and supply chain resilience capabilities: lessons for social sustainability”, *Journal of Purchasing and Supply Management*, 28(5).
- Silvestre, B. S. (2015), “Sustainable supply chain management in emerging economies: Environmental turbulence, institutional voids and sustainability trajectories”, *International Journal of Production Economics*, 167, p. 156-169.
- Statista. (2023). “Automotive industry worldwide - statistics & facts”, *Statista*, https://www.statista.com/topics/1487/automotive-industry/#topicOverview
- Tachizawa, E., & Yew Wong, C. (2014), “Towards a theory of multi-tier sustainable supply chains: a systematic literature review”, *Supply Chain Management: An International Journal*, 19(5/6), p. 643-663.
- Teece, D. J., Pisano, G., & Shuen, A. (1997), “Dynamic capabilities and strategic management”, *Strategic Management Journal*, 18(7), 509-533.
- Trapp, A. C., & Sarkis, J. (2016), “Identifying robust portfolios of suppliers: a sustainability selection and development perspective”, *Journal of Cleaner Production*, 112, p. 2088-2100.
- Tseng, M. L., Islam, M. S., Karia, N., Fauzi, F. A., & Afrin, S. (2019), “A literature review on green supply chain management: Trends and future challenges”, *Resources, Conservation and Recycling*, 141, p. 145-162.

- Vachon, S., & Klassen, R. D. (2008), “Environmental management and manufacturing performance: The role of collaboration in the supply chain”, *International journal of production economics*, 111(2), p. 299-315.
- Wilhelm, M. M., Blome, C., Bhakoo, V., & Paulraj, A. (2016a), “Sustainability in multi-tier supply chains: Understanding the double agency role of the first-tier supplier”, *Journal of Operations Management*, 41, p. 42-60.
- Wilhelm, M., Blome, C., Wieck, E., & Xiao, C. Y. (2016b), “Implementing sustainability in multi-tier supply chains: Strategies and contingencies in managing sub-suppliers”, *International Journal of Production Economics*, 182, p. 196-212.
- Villena, V. H. (2019), “The missing link? The strategic role of procurement in building sustainable supply networks”, *Production and Operations Management*, 28(5), p. 1149-1172.
- Villena, V. H., & Craighead, C. W. (2017), “On the same page? How asymmetric buyer–supplier relationships affect opportunism and performance”, *Production and Operations Management*, 26(3), p. 491-508.
- Villena, V. H., & Gioia, D. A. (2018), “On the riskiness of lower-tier suppliers: Managing sustainability in supply networks”, *Journal of Operations Management*, 64, p. 65-87.
- Xu, L., Kumar, D. T., Shankar, K. M., Kannan, D., & Chen, G. (2013), “Analyzing criteria and sub-criteria for the corporate social responsibility-based supplier selection process using AHP”, *The International Journal of Advanced Manufacturing Technology*, 68, p. 907-916.
- Zimmer, K., Fröhling, M., & Schultmann, F. (2016), “Sustainable supplier management–a review of models supporting sustainable supplier selection, monitoring and development”, *International journal of production research*, 54(5), 1412-1442.
- Zorzini, M., Hendry, L. C., Huq, F. A., & Stevenson, M. (2015), “Socially responsible sourcing: reviewing the literature and its use of theory”, *International Journal of Operations & Production Management*, 35(1), p. 60-109

Appendix

Interview Guideline OEM

Environmental vs. Social Criteria:

1. Can you describe the extent to which your organization has mapped its supply chain?
2. What are the social and environmental sustainability challenges at the sub-supplier level?
3. What social and environmental criteria are required for your suppliers/sub-suppliers? How do these criteria weigh against conventional purchasing considerations (e.g., cost, quality, and delivery times)?

Sub-Supplier Management Strategies:

4. What strategies does your company utilize to ensure sub-suppliers comply with your sustainability practices (direct vs. delegation)? Does your approach vary based on certain criteria such as product type, regional considerations, or in reaction to specific events?
5. How does your organization relay its sustainability requirements to suppliers/sub-suppliers? Are interactions primarily with sales departments or is the purchasing department of the supplier/sub-supplier also included?
6. How does your organization reward suppliers/sub-suppliers who meet or exceed your sustainability standards and how is your process for non-compliance?

The Role of the First-Tier Supplier (Double Agency Theory):

7. How integral are first-tier suppliers to your sub-supplier management strategy? Do you conduct trainings for first-tier suppliers?

Supplier Assessment & Supplier Development:

8. What approaches does your organization employ to assess sub-suppliers' adherence to sustainability criteria?
   - ⇒ What criteria determine the selection of each assessment method (does it depend on social or environmental criteria)?
   - ⇒ Is the assessment conducted in-house, or by third parties?
9. How do you support the development of your sub-supplier's sustainability capabilities?
10. What are the main obstacles to assessing or collaborating with sub-suppliers? How do these challenges impact your sustainability efforts?

Outlook:

11. How do you envision the future of sub-supplier management in terms of sustainability? Is it gaining in importance? What areas do you see as critical for future success?

Interview Guideline First-Tier Suppliers

Environmental vs. Social Criteria:

1. Which social and environmental sustainability standards are set by your direct customers (OEMs), are you aware of them and how do these standards align with your operational realities (e.g., in terms of feasibility)?

Sub-Supplier Management Strategies:

2. To what degree is your purchasing department involved in meeting the sustainability requirements set by OEMs and communicating with your sales department?
3. To what extent are your customers (OEMs) aware of your suppliers (their sub-suppliers) and do you support their sub-supplier (your supplier) management practices?
4. How do you integrate the sustainability standards required by your customers (OEMs) into your supplier management?
5. In the scenario where one of your suppliers fails to adhere to the required sustainability measures set by either your organization or the OEM, how is your process for non-compliance, and (how) do you communicate these issues with OEMs?

The Role of the First-Tier Supplier (Double Agency Theory):

6. How do you perceive your role within the sustainability efforts initiated by OEMs? Are you actively involved in shaping these strategies, or do you see yourself as an intermediary?

Supplier Assessment & Supplier Development:

7. How does your company collaborate with OEMs to foster sustainability throughout the supply chain?
   ⇒ Do you assist in the management of sustainability practices?
   ⇒ Can you share specific examples of such collaborations or support initiatives?

8. What are the primary challenges you face in managing sustainability practices among your suppliers/sub-suppliers? How do these challenges impact your ability to meet the standards required by your direct customers?

Interview Guideline Lower-Tier Suppliers

Environmental vs. Social Criteria:

1. Are you informed about the social and environmental sustainability standards set by OEMs, or do your interactions primarily involve your direct customers?
2. How do you implement sustainability within your firm/supply chain?

The Role of the First-Tier Supplier (Double Agency Theory):

3. Does the engagement of your direct customer influence your decision to undertake sustainability efforts initiated by OEMs?

Supplier Assessment & Supplier Development:

4. Would you be interested in partnering directly with OEMs to enhance sustainability compliance? Or do you already have any experiences?
5. Under what circumstances would you consider collaborating with an OEM to fulfill their sustainability criteria? What types of collaborative actions are you open to (e.g., participating in audits, receiving training)?
6. Do you prefer collaborating with third-party organizations or the in-house teams of OEMs/ your direct customers in terms of sustainability?
7. What key challenges and success factors do you encounter in sustainability collaborations? How do these impact the successful adoption of sustainability standards?

Outlook:

8. How do you foresee the future of your collaborations with direct customers and OEMs regarding sustainability? Are there areas you believe could be enhanced or need improvement?

Interview Summaries

OEMa:

Senior Specialist Sustainability & Procurement; 25.03.2024; 40min

1. We have a high level of transparency in our supply chain. Yet, the complexity of the supply chain and the variability of sub-suppliers results in some inaccuracies. It extends beyond direct suppliers and includes lower-tier suppliers. The supply chain is mapped in detail for critical/risk-prone products like rare earth metals.

2. A major challenge is the complexity of the supply chain and the fact that there is no direct control or relationships with sub-suppliers. Moreover, there are diverse laws and regulations across different regions. For example, in the case of certifications, in some countries, it is easier to obtain them (e.g., deceptive actions and bribes). This makes it challenging to understand and evaluate the sustainability practices that are in place.

3. I am unable to share any specifics. However, the social and environmental criteria align with industry standards and regulations. We treat social and environmental considerations equally, as they are both essential and non-negotiable prerequisites for doing business with us. However, occasionally, environmental aspects receive additional focus (e.g., minimum requirements for recycled materials).

4. Suppliers that want to conduct business with us need to accept our codes of conduct. First-tier suppliers are obligated to push these standards down the supply chain and to ensure that these criteria are met. Thus, under normal circumstances, sub-supplier management is delegated to first-tier suppliers. The decision to manage sub-suppliers directly is based on risk. Therefore, we employ a risk matrix that tailors sustainability criteria according to various factors (e.g., product type, origin, and material risk). Depending on the cluster, specific requirements such as certifications (e.g., ISO 14001 or 45001) are mandated. These criteria must be met by suppliers and sub-suppliers. Otherwise, they are blocked. Furthermore, we conduct comprehensive risk assessments of our supply chain to pinpoint areas that require more oversight. In cases of high risk, we take a more direct sub-supplier management approach. This can include audits, development programs, and other targeted actions. In my experience, communication is mainly conducted by first-tier suppliers. Most relevant sub-supplier

management practices are delegated to them. Only under the mentioned circumstances, they are managed directly. In the context of “directed buys”, we are sourcing the materials and components ourselves at the sub-supplier level. We then mandate our first-tier suppliers to utilize these specific materials/products and suppliers.

5. First-tier suppliers play an important role as most responsibilities are delegated to them. There are some training programs for suppliers and their procurement teams, but participation is not mandatory. However, we are in dialogues with our first-tier suppliers to emphasize our sustainability priorities and expectations.

6. Normally we communicate our sustainability requirements with the sales department of our first-tier suppliers. However, occasionally the purchasing department is also involved.

7. Sub-supplier assessment in the realm of sustainability is primarily delegated to our first-tier suppliers. However, we reserve the right to engage directly in specific situations (e.g. in reaction to detected violations) Certifications, such as ISO 14001 and 45001, are crucial for our sub-supplier management strategy. In instances of direct relationships, we mandate certifications and in instances of indirect relationships, we delegate the enforcement. Therefore, first-tier suppliers are required to possess such certifications and to ensure that their suppliers comply. The decision to engage directly with our sub-suppliers is based on various factors. This includes risk, whistleblower alerts, and random selections. To go beyond the certification process, we implement audits and self-assessment questionnaires (SAQs). These SAQs must be completed regularly, and a certain result is expected. Moreover, special audits at the sub-supplier level are initiated in response to risk or whistleblower reports. They allow for consistent monitoring, but they are predictable, and companies can prepare for them. Both internal teams and third-party organizations carry out these assessments. However, given the resource constraints, it's impractical to audit every supply chain tier.

8. There are sub-supplier sustainability development programs. However, due to resource limitations, these are limited to high-risk and critical areas. For instance, there are initiatives in Africa, where critical resources such as Cobalt are mined. Cobalt is not only critical due to its significance for electromobility but also due to sustainability violations in the mining process. We collaborated with experts and mining companies to share knowledge, resources, and investments to improve social and environmental standards. Similarly, for resources like

lithium, we prioritize transparency and select the mines ourselves that comply with our sustainability criteria. We then instruct our suppliers to procure exclusively from these sources through a "directed buy" approach.

9. Suppliers and sub-suppliers need to adhere to our sustainability criteria. If they are violated, the respective supplier and sub-suppliers are blocked. Beyond basic compliance, we recognize and incentivize suppliers who not only meet but exceed our sustainability benchmarks. This can entail monetary incentives. However, specific details of these incentives are confidential.

10. The main challenges in the evaluation and collaboration with sub-suppliers are the complexity of the supply chain and the absence of direct relationships. Additionally, is difficult to quantify and monetize social and environmental criteria.

11. Supply chain transparency will be crucial for sub-supplier management and sustainability practices. This is emphasized by new legislative measures (e.g., “German Supply Chain Act”) and growing pressures from stakeholders. To meet these standards, companies need to leverage technology and adopt proactive practices. The goal is to enable immediate access to sourcing information. This is exemplified by projects like Catena-X, which aim to create a transparent supply chain through blockchain technology (creation of a universal data room across the supply chain).

OEMb:
Procurement Manager; 02.04.2024; 35min

1. In the procurement phase, suppliers need to fill out a set of documents. These includes a template that details the suppliers our first-tier suppliers are using for sourcing. As a result, we have substantial knowledge about our supply chain (including lower tiers). In certain instances, we already use technologies such as barcode scanning and RFID chips. This enables us to automatically trace the supply chain back to the sourcing of raw materials.

2. The most challenging aspect is supply chain transparency. While I assess the sustainability criteria at the start of the contract or project phase, concrete and ongoing checks during the project phase are difficult and require a dedicated department.

3. Sustainability criteria serve as a prerequisite to qualify as a supplier. In the past, traditional factors were mainly the deciding factor. Nowadays they are still important, but the significance of social and environmental factors has increased. We have now gained a certain flexibility that allows us to place an order based on sustainability if the price falls within an acceptable range. The key determinant is the CO2 emission per procured material across the supply chain (including logistics, sourcing, and production). We conduct a business case analysis, and if the sustainability metrics meet our standards and the costs are justifiable, we prioritize the more sustainable option.

4. We are mainly delegate these responsibilities to our Tier-1 suppliers. Nonetheless, we conduct a risk assessment to determine which materials, products, suppliers, or locations require closer oversight. We often employ “directed buy” mandates for our Tier-1 suppliers to use specific sub-suppliers. This has two reasons, it enhances our control over the supply chain and quality, and it allows us to negotiate better terms (due to the large volumes that we procure). Moreover, it increases our leverage for sustainability topics. Our Tier-1 supplier can then source with our negotiated conditions. However, to directly manage our sub-suppliers is typically not our practice as we mandate our Tier-1 suppliers to manage this aspect. We only intervene in the context of risk or detected violations.

5. They are integral. We mostly mandate the sub-supplier management to our Tier-1 supplier. However, this must be in accordance with our sustainability criteria.

6. We are mainly in contact with the sales department of Tier-1 suppliers, and we mandate them to manage their supply chain according to our terms. This is enforced through codes of conduct, which every supplier is required to sign and adhere to. Occasionally, specific projects may necessitate additional criteria that also require approval. To demonstrate compliance, Tier-1 suppliers are obliged to submit all relevant documentation and evidence to our portal. For example, in matters such as steel procurement, they are required to certify through a signed declaration that their steel is not sourced from coal-dependent processes. This verification process is managed by our sustainability department which also issues sustainability questionnaires that cover a broad range of issues. This can range from the utilization of green energy and sustainable materials to the prohibition of child labor. Compliance with these is a fundamental condition for becoming one of our suppliers.

7. We have a dedicated sustainability department for the assessment of suppliers and sub-suppliers. We are using both internal and external audits, but the specifics of the sub-supplier audit process (scope and detailed criteria) fall outside my area of expertise. My involvement has been limited to first-tier audits. These were typically initiated in response to specific issues that were brought to our attention. As a result, we conducted an audit for our Tier-1 supplier to check and improve the sustainability criteria. In addition to audits, we rely on certifications such as ISO 14001 and 45001 which is a prerequisite to qualify as a supplier. These certifications are demanded from our direct suppliers, and we expect them to ensure that their lower-tier suppliers adhere to similar standards.

8. In my area of responsibility, we do not have development programs to enhance the sustainability capabilities at the sub-supplier level. They are mainly limited to our Tier-1 suppliers and to the best of my knowledge they do not include sustainability development practices. However, I am aware that other departments within our organization are engaged in sustainability related sub-supplier development programs. However, they are mainly limited to the sourcing of raw materials. My understanding is that these efforts are more of an exception than the norm.

9. We use a “traffic light” light system to evaluate the sustainability performance of our suppliers. A green status indicates full compliance, a yellow requires attention (trying to resolve the issue in cooperation with the supplier), and a red status results in the immediate blocking of the supplier until the problem is addressed. This system applies not only to sustainability standards but also to other criteria such as financial solvency. In cases where violations are identified at the sub-supplier level, we mandate our Tier-1 suppliers to manage the situation.

10. It is resource-consuming due to the complexity of the process. Moreover, getting access to the sub-supplier level is difficult. Tier-1 are typically not in favor of us engaging with their suppliers. However, for us to engage sub-supplier management practices, it must make sense and we must be able to achieve an impact. This is limited at the sub-supplier level due to the size of the firms.

11. The significance of sub-supplier management and sustainability perspective is going to increase further. This has become evident in recent years. A couple of years ago, the industry was in a phase of exploration. There was no coherent system to address sustainability

challenges. But this has changed. There are now dedicated departments that focus on this area. Additionally, the legislation is becoming more precise and detailed (e.g., German Supply Chain Act). Despite these advancements, many of the processes remain manual and time-consuming (e.g., supply chain mapping). It's clear that we're still in the early stages of this but we are starting to leverage technology for improvements. Technologies like blockchain could provide ad-hoc transparency and could play a pivotal role in sustainable sub-supplier management.

OEMc:

Project Lead: Sustainability in the Supply Chain; 09.04.2024; 1h

1. We have mapped our supply chain across multiple tiers. However, full transparency is impossible, as we have 14,000 direct suppliers from more than 60 countries. Therefore, there are some uncertainties at the sub-supplier level. Moreover, some products are produced across more than 10 tiers. We maintain full transparency for specific materials, products, and raw materials.

2. The complexity of the supply chain is the biggest challenge. Full transparency and management are impossible. But other aspects also complicate our sustainability efforts. We are operating globally, and each country has different laws and regulations which can even contradict each other. Moreover, I am feeling a power shift within the buyer-supplier relationship. In the past, as an OEM, you could mandate everything. However, some resources, products, or materials are so critical that suppliers have a huge power position. This makes our sustainability efforts more challenging. We are fully dependent on either their resources or competencies as there are only a limited number of potential suppliers. This for example the case for rare metals that are only available in certain parts of the earth. We must work together with them, even though there can be social and environmental problems.

3. Social and environmental standards serve as a prerequisite for becoming one of our suppliers. Even though the importance of sustainability has increased significantly in the last years, traditional purchasing factors such as cost, quality, or delivery times remain important. In the end, we are in the business of generating profit. These traditional factors are essential for the success of our products, our financial and operational performance and to stay competitive. However, social, and environmental topics are not “nice to have” but rather a “must have”. This is driven by various factors (legislative measures like the German Supply Chain Act, ESG

requirements, non-financial reporting obligations, and increased public scrutiny and pressure). They are monetized to some extent, but I cannot go into details on that matter.

4. We are communicating our requirements mainly through our codes of conduct. We mandate our suppliers to enforce them in their supply chain and to provide all the necessary evidence. Thus, most responsibilities are delegated. We are also conducting risk assessments based on the product/resource profile, but also based on the country of origin, legislative differences, and corruption KPIs. Each country or product/resource has an individual risk profile that determines the required proof, requirements, or actions. High-risk items are tracked, managed, and controlled more closely through audits or other activities. These risk profiles are also integrated into our supplier platform and impact the required evidence. We utilize reactive and proactive measures to ensure sustainability within our supply chain. We operate a Whistleblower Program, where any reports are investigated. If necessary, we take appropriate actions. We also implemented an AI system, which monitors over 80% of our global supplier network. The system is trained to detect potential sustainability violations by using supplier locations, production sites, and specific keywords. It conducts a comprehensive scan of the internet and media outlets. Thereby, it can detect breaches of our codes of conduct, such as strikes, fires, or accidents. Each potential incident is evaluated, and if necessary, steps are taken to resolve the matter. Our goal is to address challenges within our supply chain before they have any adverse effects on our operations. In instances where problems are identified, we collaborate with our Tier-1 suppliers to resolve the issues. Our goal is not only compliance and monitoring but also empowerment through capacity building and education. This can include sustainability trainings, webinars, workshops, panel discussions, or collaborations. The goal is to ensure that we do not have to do everything ourselves, but by giving support, our partners can do it themselves. In the end, we are not a university and not in the business of making donations. We are a business entity that tries to position itself in the best possible way for the future.

5. First-tier suppliers are crucial for our sustainability processes. We are typically delegating sub-supplier management to our direct suppliers. We mandate them to follow our requirements and to push them down the supply chain. We cannot and don´t want to manage the whole supply chain, as this is not viable. We demand all necessary evidence and in the case of violations, we are working together with Tier-1 to resolve the problem. In some cases, we are also engaging directly with sub-suppliers (in cases of criticality/risk). Moreover, we provide training modules

for our direct suppliers. The majority is not mandatory but rather optional. However, they are also open to our sub-suppliers.

6. Our communication is mainly with the sales department. However, occasionally for certain specific topics, we are also in contact with the purchasing department.

7. For certain critical products/materials/resources, we are assessing our suppliers more thoroughly. This is also the case if we are being made aware of any violations either through whistleblowers or our AI system. Based on violations, risk, or criticality, we are also engaging in audits at a sub-supplier level. They are either conducted by us or by an independent third party, depending on the specific circumstances. Typically, we delegate this responsibility to our first-tier supplier, but occasionally we need to personally assess and understand the situation. If the audit is delegated to third parties or first tiers, we screen the audit documents afterwards to ensure that everything is in line with our requirements. We have and demand the ISO 14001 and 45001 certifications from our suppliers. They must be uploaded to our supplier portal. Moreover, every supplier gets a sustainability rating. Therefore, we collaborate with a third-party supplier portal provider, where suppliers are required to submit comprehensive documentation to prove their compliance. This includes documents that show how our sustainability criteria are cascaded through the supply chain. Furthermore, we require tangible proof of compliance through certifications, training records, sustainability reports, or self-assessment questionnaires. We have set minimum benchmarks for various sustainability metrics, such as environmental protection. These are verified by either our team or an independent third party. In the case of any discrepancies, suppliers are temporarily blocked. This can include on-site audits and other monitoring practices. The sustainability ratings are calculated based on our evaluation system and are essential for our supplier assessment practices (alongside traditional criteria like cost or quality). The process of submitting the necessary documentation can require expertise and time. This might present a challenge, especially for smaller companies. While this system is primarily for direct suppliers, it is accessible to all tiers of our supply chain and many lower-tier suppliers are already participating. However, the rating is only calculated for direct suppliers.

8. Occasionally we are also engaging in development programs at the sub-supplier level for certain specific and critical products/resources. We offer training/webinars for our direct suppliers, but they are open to all sub-suppliers. However, we are not tracking exactly which

employee from which supplier is taking part. Overall, more and more suppliers are interested in these trainings and around 8,000 suppliers or their employees participate in at least one training a year. We offer panel discussions, summits, workshops, on-site training online training, and webinars. We also created an extensive document/playbook that is available for everyone and outlines how sustainability can be achieved. It includes checklists and guidance for each sustainability topic. It outlines relevant laws, human rights due diligence, governance processes, how to write a policy, how to make a risk analysis, and many other things. It entails what we expect from our suppliers and what they must upload to our supplier platform. It is a one-of-a-kind document that is specifically tailored to the automotive industry and the best of my knowledge, there is nothing similar that is publicly available. We have implemented a program called "Procurement with Purpose" that is targeted to smaller companies, start-ups, social businesses, and minority businesses. We are trying to give them a platform to grow and become viable suppliers/sub-suppliers. This allows us to prepare for the future as they are often innovative companies, and we depend on innovations. We already created important projects for series production from these collaborations.

9. Violations of any kind result in an immediate assessment and if necessary, in the blocking of the supplier until the issue is resolved. Sustainability criteria are becoming equally important than traditional factors. However, they are often more difficult to quantify and rather serve as a prerequisite. They can be monetized to some extent, depending on the context or product. There is a certain scope/range within which sustainable products can be preferred.

10. The complexity of the supply chain and the associated required resources for direct management.

11. The topic is gaining in importance. Therefore, supply chain transparency through technical innovations/solutions will be a key factor. Some tools are already available, but they need further improvements. However, transparency alone is not enough, as actions are required to establish sustainability. Moreover, it is crucial to rethink the boundaries in which companies operate. Many sustainability problems are not only subject to corporate responsibility but rather industry responsibility. Thus, industry alliances will become a crucial factor. Most OEMs source and operate in the same regions or use similar suppliers. This would allow industry collaboration to have a tremendous impact on sustainability. In general, in-house sustainability

topics are already developed. However, the biggest risk and responsibility lies within the supply chain where many things still need improvement.

Tier 1a:

Forward Sourcing Manager; 14.03.2024; 30min

1. OEMs define social and environmental sustainability standards, primarily through their codes of conduct and occasionally they specify additional requirements. Despite their importance, the traditional performance indicators remain decisive as sustainability criteria rather serve as a prerequisite and not as a deciding factor. We have established a dedicated team responsible for supplier assessment and development. These tasks are handled by our specialized department known as “Procurement and Supplier Quality”. This internal team conducts all assessments (audits, random checks, potential analyses, and supplier development). Suppliers are evaluated and rated twice a year based on purchasing criteria. In the sustainability dimension, they are evaluated based on their environmental impact, ethics, labor & human rights, and sustainable procurement practices. Sustainability topics form the basic requirements for supplier selection, but they have a marginal impact on final decisions compared to traditional criteria. This approach applies universally, regardless of the supplier's location. This ensures that all suppliers adhere to the same standards. Moreover, the participation in ECOVADIS is mandatory for suppliers. While the ECOVADIS score is crucial, it is not heavily weighted in the final evaluation. However, achieving a certain score on ECOVADIS is a prerequisite to becoming a supplier to ensure a baseline of sustainability practices across the supply chain. For some components, OEMs require that a certain percentage of the material to be recycled. Some sub-suppliers offer recycled granulate, however, their availability is limited.

2. Sustainability requirements are communicated to the sales department of our suppliers. They then convey the specifics to us (purchasing). At the start of a series production, a project team is created that includes engineering managers, project leaders, purchasing, logistics, sales, and controlling. Then every relevant party is informed about the specific sustainability requirements. However, typically they are in line with our codes of conduct and only occasionally there are extra requirements. Afterwards, we must find suitable suppliers in a short timeframe (typically only about 10 days). This often leaves little room for extensive inquiries and thus ECOVADIS and other certifications are used.

3. Generally, OEMs are familiar with our suppliers. During the part approval process, we must submit detailed documentation. This includes test results and release documents that show that our suppliers meet the required standards.

4. OEMs sustainability requirements are typically in line with our codes of conduct. However, in terms of specific requests, they are dealt with individually.

5. Normally we manage any issue internally and we are only communicating them to our client when they directly concern or impact them. But if we detect any compliance issue in the context of sustainability, the supplier is directly blocked until the matter is resolved.

6. We are following the OEMs guidelines as they are mostly in line with ours.

7. I am not aware of any collaborations beyond standard operations. Typically, the OEM issues guidelines without engaging in more extensive cooperative endeavors.

8. In developing countries supplier assessment and development practices tend to be more challenging. This is explained by limited resources, geographical distance, different regulations, and the fact that these are resource-intensive practices. However, all suppliers must adhere to the same terms and standards.

Tier 1b:
Procurement Manager Sourcing Germany; 19.03.2024; 40min

1. OEMs have specific sustainability guidelines. However, they are mostly in line with our guidelines. Our suppliers must meet these criteria and they are integrated into our supplier portal. They must sign the codes of conduct, upload the necessary evidence and they are obligated to enforce these standards within their supply chain. This is ensured through onsite audits and random product/supplier checks to verify documentation and compliance. Moreover, suppliers must annually submit self-assessment questionnaires. Assessments are conducted by both external and internal teams. Furthermore, a supplier matrix defines specific requirements that suppliers must provide. This depends on the associated risk and the area/product. These requirements can include certifications like ISO 14001, 9001, or 45001. Initially, our approach

was more lenient to allow for learning, but it has become stricter over time. Thus, all our sustainability criteria must be met. Supplier development is offered on request. However, it is mainly focused on how to fill out necessary sustainability documents (especially for smaller suppliers). However, due to the rising awareness of suppliers in terms of sustainability, this has become less of an issue. On top of that, beyond R&D collaborations, we offer two supplier development programs for best-in-class performers in all criteria (price, quality, sustainability, delivery) and for certain selected suppliers (based on adequacy and importance). This involves trainings, joint development programs, and joint investments. Overall, sustainability is a prerequisite, but traditional criteria like price still play a central role. We can choose more sustainable products when traditional criteria are closely matched and if it makes sense (in line with costs). Moreover, all suppliers face the same requirements regardless of the country or legislation. But some crucial products might be controlled more closely.

2. OEMs mainly communicate their requirements with the sales department, and they are then forwarded to us. However, for series production, a dedicated team is created with people from all functions to discuss all relevant information and specific requirements. For example, in e-mobility, there are some specific sustainability demands (e.g., no conflict materials). These are mainly focused on the environmental component and the social component servesmore as a prerequisite.

3. The awareness of OEMs regarding their sub-suppliers is product dependent. For certain products, OEMs mandate specific suppliers due to technical reasons (such as the use of specific oils). However, some supplier information might be confidential. But generally, if an OEM demands the disclosure, we disclose our supplier. Moreover, industry experts typically have a good sense of potential suppliers.

4. They are either in our codes of conduct that each supplier must sign, or they are dealt with/enforced individually.

5. Typically, non-compliance in terms of sustainability is handled internally and not communicated to OEMs. Exceptions are extreme cases, such as the inability to deliver or severe incidents that also impact OEMs. However, the preference is to address these issues discreetly due to confidentiality concerns and to seek solutions such as replacing the product or supplier.

6. We are mainly working independently in line with our terms and those of OEMs.

7. There is no cooperation with OEMs in the context of supplier development and to the best of my knowledge, we never received any sustainability training from OEMs. We only integrate the sustainability demands of OEMs in our supplier management and then we act independently.

8. The primary challenge in managing sustainability among our suppliers and sub-suppliers is the size of our supplier base, which makes the process resource intensive.

Tier 1c:
Global Purchasing Director; 20.03.2024; 30min

1. OEMs do not actively manage our suppliers. They are delegating this task 100% to us by giving us the terms that we and our suppliers must adhere to. Furthermore, they rarely interfere in how we implement these in our supply chain. Even though the criteria differ from OEM to OEM, they are mostly in line with our codes of conduct. They are generally defined beforehand, but depending on the OEM and the type of car they might differ. If an OEM wants to market/advertise their cars as environmentally friendly, the requirements for suppliers are stronger. However, some OEMs are at the forefront of sustainability. For example, one OEM demands that 40% of materials used in production must be recycled. However, the market does not necessarily offer the necessary quantities or only at a higher price level which OEMs are not willing to bear.

2. The requirements are primarily communicated with our sales department, and they then inform us. Before series production, a dedicated “task force” is created with people from all functions (purchasing, sales, controlling, etc.). There, all requirements are shared and distributed to relevant personnel.

3. OEMs know our suppliers and they are mandating their disclosure. Moreover, they can see them in the bill of material. Regarding our sub-suppliers the disclosure depends. Some cannot be disclosed depending on the type of product, or due to confidentiality.

4. We use a platform from an external provider that serves as the liaison between us and our suppliers. Every purchasing process and supplier is managed over this platform. This includes all sustainability requirements. All suppliers must upload the demanded sustainability certifications, they must sign off on the codes of conduct and once a year a supplier expectation letter is shared with additional overarching sustainability topics that must be accepted by the supplier on the platform. Overall, suppliers must be able to provide evidence and documentation of their compliance. Moreover, they need an ECOVADIS score, and they need to fill out self-assessment questionnaires. We demand the ISO14001 certification which must be uploaded to our dedicated platform. In the past, we had to check the compliance manually, but now the responsibility lies in the hands of our suppliers. If they do not comply; they are automatically blocked. For some suppliers and especially for crucial products, there are joint development programs and knowledge transfers (e.g., tech days where we and the supplier can learn from each other). These programs are mainly dedicated to overarching product and process improvement which can also entail sustainability topics. The OEMs are not included since product/process improvements often result in price advantages. OEMs would try to benefit from this situation by paying lower prices and thus limiting the positive effect for us. Overall, all supplier assessment and development practices are carried out by an internal team.

5. Typically, non-compliance is handled internally and not communicated to OEMs. The exceptions are extreme cases.

6. We mainly operate independently based on OEMs' requirements and our guidelines.

7. There is no cooperation with OEMs regarding sub-supplier management, we implement the OEMs' requirements and then act independently.

8. The size and geographic dispersion of our supplier base. This results in a resource intensive process.

Tier 1d:

Head of Purchasing Germany; 02.04.2024; 30min

1. Our interactions with OEMs regarding social and environmental sustainability are mainly governed by their codes of conduct. We are adhering to all sustainability requirements, but most of them are in line with our codes of conduct.

2. These criteria are mainly communicated with our sales department. We are trying to limit interactions of our purchasing department with OEMs to limit information disclosure. Sales is then communicating all specific requirements to us, and we are implementing them.

3. We are quite transparent as OEMs must approve our products. Thus, they are usually aware of our suppliers. Moreover, there are many "directed buys" where OEMs source their suppliers and then mandate us to use these specific suppliers. Directed buys account for approximately 50% of my procurement activities and cover most of the complex parts.

4. Generally, all social and environmental sustainability criteria serve as a minimum standard. And they are a mixture of client demands and internal standards. We have our codes of conduct that every supplier must sign, and we mandate our suppliers to manage their suppliers according to these standards. All sustainability requirements are tracked by our purchasing department or the Supplier Quality Management (SQM) department. Moreover, for certain rare resources (e.g. lithium) some special provisions and requirements supplement our codes of conduct. We are also using certifications such as the ISO 14001 which is mandatory for our suppliers. The requirements are controlled by our purchasing department and SQM and they also carry out all supplier audits. I don´t know when these audits are initiated, but as we are mainly sourcing in Europe our risk is limited. Therefore, the audits are typically not risk related. Moreover, we have dedicated supplier development programs. We only develop suppliers that are critical and that do not operate on our desired target level. In that case, we are starting with smaller projects that ultimately lead to cooperation in series production. Thereby, we can get an overview of how the specific suppliers operate and how we can assist if necessary (e.g. through technical advancement). However, sustainability topics are not the main component of our supplier development.

5. This is typically handled internally. However, if it directly affects our ability to deliver, the OEM is made aware. In this case, he is mandating us to resolve the issue. In this case, we are for instance dedicating one of our employees to actively manage our supplier on-site.

6. He is typically only delegating these activities to us, by either mandating us to manage our suppliers or by implementing a directed buy.

7. In the context of supplier assessment and development, we are not collaborating actively with OEMs. Everything is conducted by us and our dedicated Supplier Quality Management department. We have also never received any training or development programs from OEMs in that regard.

8. As we are mainly sourcing in Europe, we rarely have problems with our direct suppliers. However, with indirect suppliers, this is more difficult due to the complexity of the supply chain. Therefore, we are mandating our suppliers to manage their suppliers according to our standards. This is controlled by our Supplier Quality Management department.

Tier 1e:
Global Supplier Quality Manager; 15.03.2024; 25min

1. OEMs mainly communicate their requirements through their codes of conduct. Due to their power position, we must adhere to any requirement, otherwise we will not get the contract.

2. They are mainly communicating with the sales department. I am rarely in contact with OEMs as my focus is to ensure that our suppliers adhere to our sustainability standards.

3. Yes, they are mostly aware. To get the contract and for the client to approve our product for series production, we are mandated to provide certain documents that entail where we are sourcing from. For any parts that we purchased and that were not produced by us, the OEM is demanding additional documents. These show that we tested and checked the quality among other parameters for our suppliers. This allows the OEMs to identify our suppliers. However, our sub-suppliers are not included. But they are typically not a secret, and we can provide them if necessary. There is one simple rule in the automotive industry, the OEM is the “king” and if he wants something, we must obey.

4. Sustainability criteria serve as a prerequisite for conducting business with us. All suppliers must accept our codes of conduct and we are mandating that these terms are pushed through their supply chain. We have a portal that suppliers must use to upload all required documents and evidence. This allows my department to track their sustainability actions. If there are any violations, we notify the responsible purchasing manager who is trying to resolve the issue with the supplier. If the violation is not resolved, the supplier is blocked. We demand the ISO 14001 and an ECOVADIS score. They both must be uploaded to our supplier portal. Moreover, we are sending yearly self-assessment questionnaires to each supplier that also contain sustainability topics. This allows us to get a yearly overview of the actions of our suppliers. We are also engaging in supplier audits to monitor compliance. They are only performed by us and not by third parties. They are not necessarily risk related but rather focused on critical products and suppliers. We will conduct them on-site, by analyzing the entire process and necessary documentation. We are not engaging in supplier development programs in the context of sustainability. However, our engineering department occasionally works together with our supplier to exchange knowledge or perform a joint development program. In that case, engineering topics are at the center of activities.

5. These kinds of violations happen rarely, and they are only passed on when they directly concern the OEM. We offer a platform on our website where sustainability violations can be reported, and we are mandated to investigate all of them.

6. We are following the OEM guidelines as they are mostly in line with ours.

7. In the context of supplier assessment and development, we are not working together with OEMs. All practices are initiated and conducted by us. However, we once received a two-day training program from an OEM regarding the topic of sustainability. But generally, OEMs are not interested in our activities if everything is working, and we are adhering to their sustainability requirements.

8. As our suppliers are only located in Europe, we are facing lower risks and challenges. The standards in Europe a quite high in comparison to the rest of the world. However, our suppliers are not always sourcing from Europe. We do not have the resources to check compliance at the sub-supplier level. We are mandating our suppliers to adhere to our sustainability terms and to

push them down the supply chain, but we can only control this through self-assessment questionnaires, audits, and random controls.

Tier Na:
CEO & Head of Finance; 18.03.2024; 25min

1. We mainly supply first-tier suppliers, and we only occasionally engage directly with OEMs (only for prototype development). In terms of social and environmental sustainability, the requirements are communicated through codes of conduct, or they are communicated individually. In terms of certification, the only requirement is the ISO 9001 certification (quality management). We do not need other certifications due to our small size.

2. We are implementing sustainability mainly due to internal reasons and state subsidies. Therefore, we are using solar power and we only source locally. However, the decision to act sustainably is not necessarily fueled by our clients. Yes, there are sustainability requirements but going beyond them is not directly beneficial to our business (traditional purchasing factors still prevail). For instance, we are often tasked with repairing tools that our clients bought in low-cost countries. These tools are produced with environmentally harmful materials that are even forbidden in Europe. When we work on them, our whole production site gets smoked up.

3. No it makes no difference for us. Due to their power position, we must adhere to all requirements.

4. We would be interested if it makes sense for us. However, there have never been any collaborations with OEMs or first-tier suppliers. We only received audits from certification bodies.

5. We are willing to participate in assessment/development practices if they provide value. The process of obtaining the required certifications is very time and resource consuming. We spent a lot of resources to prepare for these audits. For us, they are more of a burden than help and we only obtain them because we must.

6. We have not worked with in-house teams, only with third-party certification providers. So, there is no conclusive answer.

7. They need to add value and not create extra work. We are a small company, and some requirements are just not viable for us and disrupt our normal business operations.

8. There will not be much change in the future as the traditional factors will still prevail. Sustainability only serves as an added benefit. But what needs to change is the bureaucracy of the processes.

Tier Nb:
Managing Director; 21.03.2024; 30min

1. Our interactions are primarily with our customers. Typically, we must adhere to their specific sustainability requirements. These are usually presented in the form of codes of conduct, and we must upload the evidence to their supplier portal. Sometimes there are additional requirements. We rarely engage with OEMs (only for prototyping).

2. To choose the right materials and suppliers is crucial for our success and sustainability is a part of these considerations. As mandated by our clients we have obtained the ECOVADIS score and the ISO 14001 certifications. Moreover, we only source from clients that are located in our proximity and in Europe. With all our suppliers we have long-term and stable relationships as we have been working with them for over 10 years. Consequently, we prioritize long-term and trust-based relationships with our suppliers. Thereby we have a deep knowledge of the operations and sustainability initiatives of our suppliers. However, we do not have any sustainability mandates as they are all subject to the same legal standards and operate in the same industry. We expect that they act in line with the laws and the normal business requirements. Since we do not have any sustainability mandates, there are no supplier audits in that context. However, for our top 8 suppliers, we perform annual audits (based on all purchasing factors, as well as sustainability). If we detect anything, we ask our suppliers to resolve the issue.

3. No not really. Due to the nature of the industry, everything is mandated top-down and we must adhere to it. For us, it does not matter who is involved.

4. We would collaborate with clients or OEMs if it aligns with our operational goals and capacities. Typically, we must accept all sustainability requirements and upload the necessary evidence. As the CEO, I must regularly conduct online trainings within the supplier portals. It is an automated process where I have to review materials and complete a multiple-choice test. For me, this does not add any value and it feels excessive. It is time-consuming and only a formality rather than a meaningful engagement. It is about shifting the responsibilities downstream. Moreover, we were never part of any on-site trainings, joint development initiatives, knowledge sharing, or joint investments. However, given our low volumes, such practices are not necessarily suited for us. The audits that we receive are typically conducted by certification companies, such as TÜV for ISO certifications (on an annual basis) We only experienced direct audits a couple of times in the last 20 years and only by OEMs. They checked on-site all our procedures, practices, and even our supply chain.

5. It must be in line with our business operations and not have a negative impact by demanding too many resources. It must be beneficial for all parties.

5. No not really. Due to the nature of the industry, everything is mandated top-down and we must adhere to it. For us, it does not matter who is involved.

6. For me both offer benefits. In general, I do not have any preferences, if they are carried out well.

7. For me, the main challenge is that they are just mandated top-down and that we need to accept any requirements demanded by OEMs and first-tier suppliers. Often, they are not in line with our business landscape, and they create obsolete work.

8. We understand that OEMs can only do that much, and I think they cannot do much differently due to the size and complexity of the supply chain. However, the process should be less like school. They must understand that they work with professional companies and that most of these learning modules feel like unnecessary work. The interactions should be less top-down and focus more on the human and personal components. In the last years, everything has become less humanized, and every requirement is just mandated top-down without any personal interactions. Communication and collaboration are mainly via web portals, however, in my

opinion, human interaction is the best way to do business to achieve trust and compliance regarding sustainability topics.

Tier Nc:
Business Development Manager; 21.03.2024; 30min

1. We mainly interact with our direct clients rather than OEMs. Typically, the requirements are communicated through codes of conduct and additional provisions. We must sign them and provide evidence. If these sustainability requirements change, we must acknowledge them and sign off on the updated versions. We typically accept all requirements, but should any present a challenge for us, we highlight these and initiate a dialogue to find a resolution. Moreover, most requirements are consistent across our customer base.

2. Our approach in terms of sustainability is based on the codes of conduct that are provided by our parent company. These codes are comprehensive, and they address both social and environmental sustainability. The foundation of our supplier relationships is built on long-term relationships. This allows us to understand our suppliers in the context of sustainability. Moreover, we serve a similar customer base with similar requirements. Thus, we do not explicitly mandate our suppliers to comply with any sustainability requirements. The only exception is if we receive any special sustainability mandates that are limited to one project. These we communicate.

3. No, this does not make a difference.

4. We would be interested if it makes sense for us. However, my experiences are limited. The interactions with OEMs and first-tier suppliers are normally only in the context of sustainability compliance. Therefore, if we comply, they typically do not care about how we incorporate them. Over recent years, we engaged in two joint development projects with start-up OEMs and our parent company. They were dedicated to the development of a car's interior. The focus has been on R&D and engineering. However, topics like material recyclability and selection are a side topic (only environmental topics). Moreover, the evaluations of our sustainability practices are mainly conducted by certification bodies and not by OEMs or first-tier suppliers directly. Furthermore, our CEO has participated in online training related to sustainability.

5. We are always open to input, but it must fit our business landscape and it must provide value and not be a burden. Joint development practices are always beneficial for all parties, but sustainability topics are normally only a side project as the focus is on the product itself.

6. I prefer third parties as they are unbiased and independent. This allows for an actual relationship with our customers and OEMs. All side topics can be put aside, and the focus can be on business.

7. It must fit our concrete business landscape and it must be beneficial without creating extra work for anyone.

8. I understand that it is impossible for OEMs to fully understand and manage their supply chain. It is even difficult for us in our operations. For example, when dealing with our parent company we often don´t know where they are sourcing from. Moreover, I support and value certifications such as ISO because they set a global standard. In my opinion, companies that want to participate in the automotive supply chain should all adhere to these standards and obtain these certifications. OEMs should mandate these certifications and not directly engage with their suppliers or sub-suppliers on these issues. The responsibility should be delegated to independent certification bodies who are experts in their fields and can offer an unbiased perspective. This would allow OEMs to concentrate on core business and foster human connections. This creates an actual relationship, trust, and ethics.

Coding Table

Second Order Codes	First Order Codes	Tier	Identifier	Quotation
Purchasing Criteria	Supply-Chain Mapping	OEM	OEMa	"Our supply chain is quite well mapped. This is not only the case for first-tier suppliers, but also for lower-tier suppliers, especially in the case of critical materials or products. In this case the mapping extends to the whole n-tier supply chain, including the sourcing of raw materials."
		OEM	OEMb	"We require our suppliers to fill out a set of documents, including a template that details the suppliers that Tier-1 are currently and planning to use for sourcing."
		OEM	OEMb	"We have adopted technologies such as barcode scanning and RFID chips to enable us to automatically trace products back to the sourcing of raw materials."
		OEM	OEMc	"We have mapped our supply chain across multiple tiers. But full transparency is impossible, as we have 14,000 direct suppliers from more than 60 countries. [...] Some products are produced across more than 10 tiers. We maintain full transparency for some specfic products."
		Tier 1	Tier 1a	"OEMs are familiar with our suppliers because, during the part approval process, we must submit detailed documentation, including test results and release documents that show that our suppliers meet the required standards."
		Tier 1	Tier 1b	"We are only disclosing our suppliers if asked. However, everyone that conducts business in the automotive industry is aware of the fact that there are only so many options that you can source from."
		Tier 1	Tier 1c	"The OEM demands information regarding our suppliers and we adhere to that."
		Tier 1	Tier 1e	"Yes, they are mostly aware. To get the contract and for the client to approve our product for series production, we are mandated to provide certain documents that entail where we are sourcing from. For any parts that we purchased and that were not produced by us, the OEM is demanding additional documents that show that we tested and checked the quality and other parameters for our suppliers."
	Social & Environmental Challenges at Sub-	OEM	OEMa	"It is mainly about the complexity of the supply chain, but also about the quantifiability of sustainability criteria. For example, how can I measure the CO2 impact?"
		OEM	OEMb	"The most challenging aspect is to track our complex supply chain. This requires a dedicated department."
		OEM	OEMc	"The complexity of the supply chain is the biggest challenge. But there are other aspects that also complicate our sustainability efforts. Each country has different laws and regulations which can even contradict each other. Moreover, I am feeling a power shift within the buyer-supplier relationship. Some materials are so critical that suppliers have a huge power position and are thereby making our sustainability initiatives more difficult."
		Tier 1	Tier 1a	"In developing countries or low-cost countries, the oversight of sustainability practices tends to be more challenging due to limited resources, geographical distance, different regulations and the extensive effort required for monitoring."
		Tier 1	Tier 1b	"We do not have the resources to directly control and support every member of our supply chain. We must choose these processes strategically."

	Social & Environmental Criteria	OEM	OEMa	"Based on the risk classification, origin and cluster within our strategic matrix there are different sustainability criteria that must be fulfilled and confirmed by our suppliers."
		OEM	OEMa	"Social and environmental criteria are tackled in the same regard and both serve as a prerequisite for doing business with us. If they are not confirmed, suppliers are blocked."
		OEM	OEMb	"Sustainability criteria serve as a prerequisite to qualify as a supplier. Traditional criteria are the deciding factor but we have now gained a certain flexibility to allows us to place an order based on sustainability if the price falls within an acceptable range. [...] The key determinant is the CO2 emission per procured material across the supply chain and if the costs are justifiable, we prioritize the more sustainable option."
		OEM	OEMc	"These traditional factors are essential for the success of our products, our financial and operational performance and to stay competitive. However, social and environmental topics are not a nice to have anymore, but rather are considered a must have. "
		Tier 1	Tier 1a	"Sustainability topics have gained in importance, however, the traditional performance indicators often remain decisive in supplier selection and evaluation. Sustainability criteria rather serve as a prerequisite and not as a deciding factor."
		Tier 1	Tier 1a	"For some components like bumpers, OEMs may require a certain percentage of the material to be recycled. This involves reprocessing old bumpers into granulate for use in new products. Some sub-suppliers offer recycled granulate, however, the availability of such recycled materials can be limited, which makes this demand challenging."
		Tier 1	Tier 1b	"All our suppliers must adhere to the same terms set in our codes of conduct. There is no differentiation. There is also no differentiation between social and environmental criteria, as they both serve as prerequisite for doing business with us. However, depending on the cluster in our risk matrix, additional proofs, documents and certifications are required. [...] Sometimes additional sustainability criteria can be monetized, but this has to be within a certain price range."
		Tier 1	Tier 1b	"On one hand, depending on the criticality of the product, a special emphasize is placed on certain materials, products and suppliers. They are then more closely managed and monitored. On the other hand, for critical products one might be more inclined to make concessions to some extent."
		Tier 1	Tier 1c	"The topic of sustainability is differently defined from OEM to OEM. We are conducting business with every OEM and the basics sustainability criteria are similar for all OEMs and in line with our own Codes of Conduct. However, on the environmental component, some OEMs demand more than others. This can include specific requirements for the minimum use of recycled and recyclable materials in production."
		Tier 1	Tier 1c	"Some environmental criteria are difficult to fulfill, as the market for example does not offer recycled materials in the necessary quantities and price segments. OEMs however, are not inclined to pay more for more sustainable products. This puts pressure on us and our supply network."
		Lower Tier	Tier Na	"We are mainly in contact with our direct customers (Tier 1). They are communicating their sustainability criteria directly to us. We have no direct information regarding the OEMs requirements. […] These sustainability requirements however are very thin and mainly limited to their codes of conduct. Sometimes Tier 1 suppliers are buying low-cost tools from China, that are then due to low quality brought to us for improvements. Mostly these tools are produced with low quality and even with materials that are forbidden in Europe. When working on them, our whole production site gets smoked up."
		Lower Tier	Tier Na	"For us it is only viable to further improve our sustainability due to state subsidies, but not due business reasons."
		Lower Tier	Tier Nb	"We are receiving the sustainability and compliance criteria from our customers. Interactions with OEMs are rarely. On top of that as we are a subsidiary of Tier-1 Supplier and thus we are also subject to these terms and codes of conducts. […] Most OEMs and Tier 1 have webportals and you can only conduct business with them, if you agree to all terms and upload all necessary documents."
		Lower Tier	Tier Nc	"The sustainability requirements that we are receiving are mostly not project dependend. We receive them when we get unboarded. We get all the documents to read through. We only get informed when this requirements change or when there are any project related specific requirements."
		Lower Tier	Tier Nc	"Due to the power position of our customers and the OEMs, I cannot imagine that there are any terms that we would not accept. But most requirements are similar."

	Communication of Purchasing Criteria	OEM	OEMa	"The first contact point with our suppliers is always sales, but occasionally, we are also engaging with the purchasing department. […] Our sustainability requirements are mainly dictated through our supplier code of conducts, that must be accepted by our suppliers. Occasionally there are further requirements, especially in the realm of environmental criteria. These are then communicated on an individual basis."
		OEM	OEMb	"We are mainly in contact with the sales department, and we are mandating them to manage their supply chain according to out codes of conduct. Every supplier is required to sign them and sometimes, specific projects may necessitate additional criteria that also require approval. To demonstrate compliance, Tier-1 suppliers are obliged to submit all relevant documentation and evidence to our portal. Compliance with these is a fundamental condition for becoming one of our suppliers."
		OEM	OEMc	"Our communication is mainly with the sales department. But occasionally for certain specific topics we are also in contact with the purchasing department."
		Tier 1	Tier 1a	"Sustainability requirements are primarily communicated to Sales, which then conveys the specifics to the us. At the start of a series production a project team is created that includes engineering managers, project leaders, purchasing, logistics, sales, and controlling. This team is introduced to the components involved and it decides on make-or-buy scenarios for components. Afterwards, we must find suitable suppliers in a short timeframe, typically only about 10 days. This often leaves little room for extensive sustainability inquiries and thus ECOVADIS and other certifications are used."
		Tier 1	Tier 1b	"Specifc sustainability requirements are communicated with Sales and they then inform us. This is common especially in the e-mobility industry, where the focus is on having environmentally friendy products and supply chains. If necessary we (purchasing department) adapt our sourcing and the terms for our suppliers accordingly."
		Tier 1	Tier 1c	"All the sustainability criteria of OEMs are communicated with our sales department. Before the series production starts, a project team is created with all relevant functions. This includes sales, purchasing, controlling etc. There, all requirements and specifics are shared and distributed to relevant personnel. Based on this a sourcing decision is then made."
		Tier 1	Tier 1d	"We are working closely together with OEMs for many parts, as they must approve our product. Thus, they are usually aware of our suppliers as we are quite transparent."
		Tier 1	Tier 1d	"These criteria are mainly communicated with our sales department, as we are trying to limit the purchasing departments interactions with our clients."
		Tier 1	Tier 1e	"They are mainly communicated with our sales department. […] I am rarely in contact with OEMs."
		Tier 1	Tier 1e	"There is one simple rule in the automotive industry, the OEM is the "king" and if he wants something, we obey."

	Integration of OEMs Sustainability Criteria	Tier 1	Tier 1a	"OEMs define social and environmental sustainability standards, primarily through their codes of conduct and occasionally they specify additional requirements."
		Tier 1	Tier 1a	"We have established a dedicated team responsible for assessing and developing supplier´s sustainability practices known as "Procurement and Supplier Quality". This internal team conducts all assessments including audits and random checks as well as supplier development programs. Suppliers are evaluated and rated twice a year regarding quality, logistics, sustainability etc. In the sustainability dimension, they are evaluated based on their environmental impact, ethics, labor & human rights, and sustainable procurement practices. [...] This approach applies universally, regardless of the supplier's location."
		Tier 1	Tier 1b	"All suppliers must sign and accept our codes of conducts. They not only include terms that our suppliers must adhere to, but also terms that we must adhere to. All new suppliers must sign them and curently we are in the process of letting every existing supplier sign them. We mandate our suppliers to enforce these terms within their supply network. However due to the complexity of the supply chain, control is difficult. We are trying to control this by using audits and doing random samples in the context of sustainability."
		Tier 1	Tier 1c	"We have implemented the `SupplyOn´platform through which we are managing our suppliers, also in the context of sustainability. Within this platform we have our code of conducts that all suppliers must accept and we have defined all the sustainability criteria that must be met. Our suppliers have to upload their certifications and ECOVADIS score and yearly we are distributing our sustainability goals that must be accpeted by our suppliers. [...] Any specifc requirements are communicated indivually and they must be accepted
		Tier 1	Tier 1d	"Sustainability criteria serve as a minimum standard to qualify as a supplier. They are communicated through our codes of conduct that every supplier must agree to and sign. We mandate our suppliers to manage their suppliers according to these standards, but this is not tracked by us. For certain rare resources (e.g. lithium) there are special provisions and requirements that supplement our codes of conduct. [...] We have a dedicated department "Supplier Quality Management" that is tasked with the sustainability topics and that conducts supplier assessment and development programs."
		Tier 1	Tier 1e	"OEMs mainly communicate their requirements through their codes of conduct. Due to their power position, we must adhere to any requirement, otherwise we will not get the
		Tier 1	Tier 1e	"Sustainability criteria serve as a prerequisite for conducting business with us. All suppliers must accept our codes of conduct and we are mandating that these terms are pushed through their supply chain. We have a portal that suppliers must use to upload all required documents and evidences."
		Lower Tier	Tier Na	"The motivation to act sustainable is mainly based on intrinsic motivation and state subsidies. For us sustainability is important but no major concern, as we only source from local suppliers that we know and that must adhere to the same standards than us."
		Lower Tier	Tier Nb	"Working sustainable is both an intrinsic and extrinsic motivation. We ourselves have ISO14001 and ECOVADIS, but we are not mandating our suppliers directly any sustainability requirements. They are all long-term and local suppliers, we know them and their operations very well. [...] We would rarely change long-term suppliers for price reason as this
		Lower Tier	Tier Nc	" We internally have a codes of conduct, but we are not mandating them to our suppliers. Our suppliers are all in the same industry and we share similar clients. Thus, we are not mandating certain certifications and signed code of conducts. We rather rely on the fact that they are all in the automotive industry and subject to the same laws and requirements

Sub-Supplier Management Strategies	Delegation	OEM	OEMa	"Mainly we are speaking with our first-tier suppliers and we are mandating them to push our sustainability requirements down the supply chain."
		OEM	OEMb	"We are mainly delegating these responsibilities to our Tier-1 suppliers. Nonetheless, we conduct risk assessments to pinpoint materials, products, suppliers, or locations that require closer oversight. [...] Enforcing sustainability standards on sub-suppliers is typically not our practice, we mandate our Tier-1 suppliers to manage this aspect. We only intervene in the context of risk and mandate our Tier-1 to take a closer look."
		OEM	OEMc	"We are communicating our requirements mainly through our codes of conduct. We mandate our suppliers to enforce them in their supply chain and to provide all the necessary proves within the supplier portal."
		Tier 1	Tier 1a	"I am not aware of any collaborations beyond standard operations. Typically, the OEM issues guidelines for us to follow without engaging in more extensive cooperative
		Tier 1	Tier 1b	"The OEM is delegating this task to us. We are using our codes of conduct and terms and only extend them if the OEM has further specific demands."
		Tier 1	Tier 1c	"The OEM is not actively managing our suppliers (his sub-suppliers). He is delegating this 100% to us by giving us the terms that we and our suppliers must adhere to. He does not interfere in how we implement this in our supply chain. […] We ourselves have supplier development and assessment processes. We have a dedicated teams that handle supplier quality assessmen and development practices in the context of sustainability. We do not use third parties."
		Tier 1	Tier 1d	"These activities are typically delegated to us, by either mandating us to manage our suppliers or by implementing a directed buy."
		Tier 1	Tier 1e	"We are not working together with OEMs, as all proccesses are conducted by us. [...] We once received a two-day sustainability training program from an OEM. But generally, OEMs are not interested in our activities if everything is working, and we are adhering to their sustainability requirements."
		Lower Tier	Tier Na	"We are mainly in contact with our direct customers (Tier 1). They are communicating their sustainability criteria directly to us. We have no direct information regarding the OEMs
		Lower Tier	Tier Nc	"Normally we only have contact with our customers (Tier 1) and not OEMs. We are only in contact with them if we are conducting business directly with them and in the context of
	Adaption of Sub-Supplier Strategies	OEM	OEMa	"We are conducting a risk analysis to identify for which materials, components or sub-suppliers we have to enter the supply chain more extensively by managing our sub-suppliers and which we can delegate to our first-tier suppliers."
		OEM	OEMa	"We include in all contracts the right that we can directly access our sub-suppliers."
		OEM	OEMc	"We are also conducting risk assessments based on the product/resource profile, but also based on the country of origin, legislative differences or corruption KPIs. Each country or product/resource has an individual risk profile that determines the required proves, requirements or additional actions."
		OEM	OEMc	"We use both reactive and proactive measures. On the reactive side, we operate a whistleblower program, where we investigate any reports and if necessary, take appropriate actions. On the proactive side, we use an AI system, which is trained to detect potential sustainability violations by using supplier locations, production sites, and specific keywords. It conducts a comprehensive scan of the internet and media outlets for any breaches of our code of conduct, such as strikes, fires, or accidents. Each potential incident is thoroughly evaluated, and if necessary, steps are taken to resolve the matter. Our goal is to address challenges within our supply chain proactively before they have any adverse effects on our

GG

	Direct Management	OEM	OEMa	"Occasionally we are engaging in ´directed buys´ where we are sourcing our sub-suppliers ourselves and then mandate our first-tier suppliers to use these choosen suppliers as their suppliers. […] For resources like Lithium, we select the mines ourselves that comply with our sustainability criteria. We then instruct our suppliers to procure exclusively from these
		OEM	OEMa	"Due to the complexity of our supply chain, it is impossible to manage all of our sub-suppliers directly through processes like audits. We have to select the materials, components or sub-supplier that we manage directly strategically."
		OEM	OEMb	"Occasionally, we employ "directed buy" mandates for our Tier-1 suppliers to use specific sub-suppliers or [...] we purchase components directly and supply them to our Tier-1
		OEM	OEMc	"In the case of problems, we collaborate with our Tier-1 suppliers to resolve the issues by conducting audits or other actions."
		OEM	OEMc	"Our goal is not only compliance and monitoring, but also empowerment through capacity building and education. This can include sustainability trainings, webinars, workshops, panel discussion or collaborations."
		Tier 1	Tier 1b	"Sometimes, OEMs source their sub-suppliers themselves and they then demand that we use their choosen sub-suppliers."
		Tier 1	Tier 1d	"There are many "directed buys" where the OEM sources suppliers and then mandates us to use these specific suppliers. This covers around 50% of our procurement activities and most of the complex parts."
		Lower Tier	Tier Na	"We are rarely in contact with OEMs and we have never received any audits or development programs directly from OEMs. There have been dialogues with first-tier suppliers, but
	Reward & Punishment for Compliane/Non-Compliance	OEM	OEMa	"In the case of non-compliance, suppliers and sub-suppliers are blocked. The sustainability requirements serve as a prerequisite and there is a further monetization of sustainability criteria that influence the selection of suppliers, but due to confidentialty reasons, I cannot go more into detail."
		OEM	OEMb	"We use a "traffic light" light system to evaluate the sustainability performance of our suppliers. A green status indicates full compliance, a yellow requires actions that we then communicate with the supplier for resolution, a red status results in the blocking of the supplier until the problem is addressed. [...] In cases of violations at the sub-supplier level, we first mandate our Tier-1 suppliers to manage the situation."
		OEM	OEMc	"Violations result in an immediate assessment and if necessary, in the blocking of the supplier until the issue is resolved. Sustainability criteria are becoming equally important as traditional factors, but they are often more difficult to quantify and rather serve as a prerequisite. They can be monetized to some extent, depending on the context or product. There is a certain scope/range within which sustainable products can be preferred even though they are scoring lower in traditional factors."
		Tier 1	Tier 1a	"Normally we manage any issue internally and we only communicate them when they directly concern or impact our client. But if we detect any compliance issue in the context of sustainability, the supplier is directly blocked until the matter is resolved."
		Tier 1	Tier 1b	"Violations are dealt with internally and they are only communicated with OEMs in extreme situations. This can occure due to our inability to deliver as we had to stop production or due to the severity of the violations. But normally we have alternative suppliers that we can use and to my knowledge, there never was such a severe sustainability violation that we had to report that to the OEM. If we detect any violations, the supplier is blocked until further notice or until the issue is fixed."
		Tier 1	Tier 1d	"This is typically handled internally. However, if it directly affects our ability to deliver, the OEM is made aware. In this case he is either demanding that we are handling it, by dedicating one of our employees to actively manage our supplier on site or occasionally, we are also doing this together with the OEM."
		Tier 1	Tier 1e	"These kinds of violations happened rarely and are only passed on when they directly concern the OEM. We have a platform on our website where sustainability violations can be reported. We are mandated to investigate all of them. If we are made aware or if we detect any violations, the supplier is blocked until resolution of the issue."

The Role of the First-Tier Supplier	The Role of the First-Tier Supplier	OEM	OEMa	"Mainly we are speaking with our first-tier suppliers and we are mandating them to push our sustainability requirements down the supply chain."
		OEM	OEMb	"We are mostly mandating Tier-1 to independently manage their supply chain in accordance with our sustainability criteria."
		OEM	OEMc	"First-Tier suppliers are crucial for our sustainability processes, as we cannot and don´t want to manage the whole supply chain. [...] We provide obtional training modules for our direct suppliers."
		Tier 1	Tier 1c	"In the 16 years that I am working at [company XY] the purchasing department has never received a sustainability training or cooperation from an OEM."
		Tier 1	Tier 1d	"We never received any training from OEMs in the realm of sustainability."
Supplier Assessment	Certifications	OEM	OEMa	"Certifications are crucial to manage our complex supply chain. However, solely relying on certifications is insufficient for a comprehensive sustainability strategy. First-tier suppliers are required to possess such certifications and to ensure that their suppliers comply. However, additional measures are necessary to manage sustainability. [...] They are only conrolled based on risk assessments and random samples."
		OEM	OEMb	"We rely on certifications such as ISO 14001 and 45001 which are a prerequisite to qualify as a supplier. These certifications are demanded from our direct suppliers, and we expect them to ensure that their lower-tier suppliers adhere to similar standards."
		OEM	OEMc	"We have and demand the ISO14001 and 45001 certifications from our suppliers."
		OEM	OEMc	"We implemented a mandatory sustainability rating for each direct supplier. We have a third-party supplier portal provider, where suppliers are required to submit comprehensive documentation to prove their compliance through certifications, training records, sustainability reports, or self-assessment questionnaires. We have set minimum benchmarks for various sustainability metrics, such as environmental protection. These are verified by either our team or an independent third party. In the case of any discrepancies, suppliers are temporarily blocked. The sustainability ratings are calculated based on our evaluation system. [...] While this system is primarily for direct suppliers, it is accessible to all tier of our supply chain and many lower-tier suppliers are already participating."
		Tier 1	Tier 1a	"Having an ECOVADIS score is mandatory for suppliers. While the ECOVADIS score is crucial, it is not heavily weighted in the final evaluation. However, achieving a certain score on ECOVADIS is a prerequisite to becoming a supplier."
		Tier 1	Tier 1b	"We have a supplier matrix. Depending on the type of product and the associated risk, the supplier must have certain documents and certifications. NDA and signed codes of conduct are always a prerequisite, but this can also extend to certifications like ISO14001. They have to upload the necessary proof in our system. They are regularily checked by our sustainability department. In the case of non-compliance the purchasing manager has specifically ask for these proofs, otherwise the supplier will be blocked."
		Tier 1	Tier 1d	"We are having all the necessary certifications and some we are demanding from our suppliers like the ISO 14001."
		Tier 1	Tier 1e	"We have the ISO 14001 certification and to conduct business with us, we mandate our suppliers to also obtain it among other certifications. We are also requiring an ECOVADIS
		Lower Tier	Tier Na	"Yes some certifications are demanded, but no sustainability certifications. The only certifications that is demanded from above is the ISO 9001 (Quality Management). We are only obtaining this certifications because we have to. For us it is unecessary work, a lenghty and costly process that is not viable for us. At the end many ressources are wasted for the preperation of the yearly audits."
		Lower Tier	Tier Nb	"We are mandated by our parent company to have the ISO 14001 certification. This is also demanded by some customers, similar to the ECOVADIS score."

	Audits	OEM	OEMa	"In the case of risk, we are conducting special audits at the sub-supplier level, as we realized that certifications are more easily obtained in other countries. Due to the standardization of the audit process, firms can prepare and they are often spending more resources on the preparation then on the enforcement of the sustainability standards. [...] We are conducting special audits either due to the associated risk our when we get hints through our whistleblowing program. [...] They are conducted by both internal and external audit teams."
		OEM	OEMb	"We have a dedicated sustainability department for the assessment of suppliers and sub-suppliers, this includes audits."
		OEM	OEMc	"Based on violations, risk, or criticality, we are also engaging in audits at sub-supplier level. They are either conducted by us or an independent third party. Typically, we delegate this responsibility to our first-tier supplier, but some things we need to assess and understand firsthand. If the audit is delegated to third parties or first tiers, we are afterwards screening the audit documents to ensure that everything is in line with our requirements."
		Tier 1	Tier 1b	"We are conducting supplier audits ourselves, but we are also using third parties. However, we have a dedicated team that is soley responsible for supplier assessments."
		Tier 1	Tier 1d	"All audits are conducted by our SQM department. [...] As we are mainly sourcing in Europe our risk is limited and the audits are typically not risk related. However, if a supplier is located outside of Europe, we are assessing the supplier and supply chain more closely."
		Tier 1	Tier 1e	"We are sending yearly self-assessment questionnaires to each supplier. We are also engaging in supplier audits. They are only performed by us and not by third parties and are not risk related. They are mainly focused on critical products and suppliers. [...] We are conducting random samples to check our sub-suppliers adherence to sustainability criteria. Our supplier must show us that he did his due diligence and that he can provide all necessary documentation."
		Lower Tier	Tier Na	"We have never received any audits from internal teams of OEMs or first-tier suppliers, only in the context of obtaining our ISO certification."
		Lower Tier	Tier Nb	"For our top 8 suppliers we are conducting a yearly review (not audit) of our purchasing parameters. This includes their sustainability initiatives, for example ISO 14001
		Lower Tier	Tier Nb	"We normally only receive audits from the certification bodies, but occasionally we have received direct audits from OEMs. They came on-site and inspected all our processes, procedures, and even our supply chain."
		Lower Tier	Tier Nc	"Apart from the audits that we are receiving for our certifications, we have never received any additional audits from OEMs or first-tier suppliers. However, we have a yearly internal audit from our parent company. The only thing that we are getting from our customers in that regard are self-assessment questionnaire that we have to fill out."
Supplier Development	Training	OEM	OEMa	"There are no mandatory sustainability trainings for our suppliers and sub-suppliers. There are dialogs where we communicate what we expect and what we are looking for."
		OEM	OEMc	"We offer trainings for our direct suppliers, but they are open for all sub-suppliers. More and more suppliers are interested in these trainings and around 8 000 suppliers or their employees are participating in at least one training a year. We also created an extensive document/playbook that is available for everyone and outlines how sustainability can be achieved. It includes checklists and guidance for each sustainability topic which can be especially beneficial for smaller companies. It outlines relevant laws, human rights due diligence, governance processes, how do it write a policy, how to make a risk analysis and many other things. These are all things that we expect from our suppliers and that they must prove/upload in our supplier platform. It is a one-of-a-kind document that is specifically tailored to the automotive industry and to the best of my knowledge, there is nothing
		Lower Tier	Tier Nb	" In the context of the webportal, I regularily have to click through a learning module on the topic of sustainability. It feels a bit like school and at then end I have to do a multiple choice test. […] I have to do it for both OEMs and first-tier suppliers. They just want to write off the responsibility."
		Lower Tier	Tier Nc	"I have never received any training, only our CEO. But it is always an online training and it is only for them to push the resonsibility down the supply chain."

	Ressource and Knowledge Transfer	OEM	OEMa	"There are some targeted sub-supplier sustainability development programs. They are used mostly in parts of the supply chain where we see a huge criticality in terms of sustainability. For instance, we have engaged in initiatives in Africa, where critical resources such as Cobalt are mined. Cobalt is not only critical due to its significance for the electromobility, but also due to occurring sustainability violations in the mining process. Thus, we engaged in direct management practices. We collaborated with experts and mining companies to share knowledge, resources, and investments to support the adoption of more sustainable practices in adherence to both social and environmental standards."
		OEM	OEMb	"Some departments within our organization are engaged in sustainability related sub-supplier development programs. To the best of my knowledge, that is however mainly limited to the sourcing of raw materials. But my understanding is that these efforts are more the exception than the norm."
		OEM	OEMc	"We have a program called "Procurement with Purpose". It is targeted to smaller companies, start-ups, social businesses, and minority businesses. We are trying to give them a platform to grow and to potentially become a viable suppliers/sub-supplier. At the very least, it allows us to do a good deed for society. We are offering trainings or on-boardings to prepare them for future business. This allows us to prepare for the future as they are often innovative companies, and we depend on innovations. We already created important
		Tier 1	Tier 1b	"Upon request, we support suppliers in sustainability topics. However, we assume that our suppliers can manage these topics themselves. If we support, then it is mainly in the context of filling out our demanded documents. However, due to rising awareness of suppliers in terms of sustainability, this becomes less of an issue. To the best of my knowledge, there is no cooperation with OEMs regarding supplier development [...] and, we never received any sustainability training from OEMs. We offer two supplier development programs for best-in-class performers in all criteria (price, quality, sustainability, delivery) and for certain selected suppliers (based on adequacy and importance). This then involves training, potential knowledge transfers, joint development programs and joint investments."
		Tier 1	Tier 1c	"For production realted topics and supplier, we have ´tech days´with our suppliers. This is an exchange of information and knowledge from both sides. It includes discussions on how to improve the functionality of the product, with sustainability beeing a sidetopic. However, the OEM is not included as the OEM would try to use cost savings and other
		Tier 1	Tier 1d	"We are developing our suppliers by first engaging them in smaller projects. This allows us to gain an overview of how they operate and how we can assist. [...] Sustainability topics are not the main component of the supplier development, but they can be a side topic if necessary."
		Tier 1	Tier 1d	"We don´t collaborate with OEMs in supplier assessment and development. Everything is conducted by our SQM department. [...] Any price advantages through development practices will be imposed back to us by OEMs as they are lowering the prices that they are willing to pay."
		Tier 1	Tier 1e	"We do not have any sustainability supplier development programs, they are mainly limited to the engineering processes."
		Lower Tier	Tier Na	"We were never part of any supplier development programs, but we would be open if it makes sense for us and actually provides value."
		Lower Tier	Tier Nc	"We are mainly doing build to print, so we are getting drawings and we make the product accordingly. Thus, supplier development programs are not really suitable to us. […] However, we had joint development programms with start-up OEMs, where we together with our parent company worked on the interior and light system of a car. [...] It was mainly focused on product specifc details, but some sustainability topics, like recycling have been a part of the conversation."

Other	Future Outlook	OEM	OEMa	"It is all about creating transparency within the supply chain. It must be possible to access information about the origins, conditions of procurement, and specific requirements that suppliers must meet, without conducting extensive and resource intensive research. They key will be to leverage technology like the Cartena X project that tries to leverage blockchain technolgy to increase transperency."
		OEM	OEMb	"The significance of managing sub-suppliers from a sustainability perspective is going to increase further. In the past, there was no clear system for sustainability challenges. Now there are dedicated departments, processes and the legislation is becoming more precise and detailed."
		OEM	OEMb	"Much of the processes are manual, time-consuming, and still in the early stages but we are starting to leverage technology like blockchain for improvements. They could provide ad-hoc transparency."
		OEM	OEMc	"The topic is gaining in importance. In the future, it will be crucial to create more transparency within the supply chain through technical innovations/solutions. There are tools that are already available, but they need further improvement. However, transparency alone is not enough, as actions are required to establish sustainability."
		OEM	OEMc	"It will be crucial to rethink the boundaries in which companies operate. Many sustainability problems are not only within the realm of corporate responsibility, but rather industry responsibility. Thus, industrial alliances will become a crucial factor. Most OEMs source and operate in the same regions or use similar suppliers. This could allow industry collaboration to have a tremendous impact on sustainability."
		OEM	OEMc	"In general, in-house sustainability topics are already developed pretty far. However, the biggest risk and responsibility lies within the supply chain where many things still need
		Lower Tier	Tier Na	"I don´t think that anything will greatly change in the future. The traditional purchasing factors will still prevail."
		Lower Tier	Tier Na	"The focus should be more on creating value and to not be a burden."
		Lower Tier	Tier Nb	"I understand that they cannot do much different from what they do since they have global supply chains. However the process should be less school like and they need to understand that they are dealing with professional companies. The process should be less top-down and more focused on the human side."
		Lower Tier	Tier Nc	"It is impossible for the OEM to fully understand what is going on in their supply chain and to manage it. This is even impossible for us. […] I like and agree with the certifications like ISO and I think they should be global and worldwide. Companies that want to work in the automotive industry should obtain these. The relationship between the customer and the supplier should not entail any of the processes like audits. That way you have the least biased and best process. The focus should be on the human component and that way a real relationship can be created. The focus can be on business and all other sidetopics can be put aside."