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Supplier Environmental Governance in Global Supply Chains

Multiple Case Study of Finnish Multinational Corporations

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ABSTRACT:

Environmental sustainability is a central challenge in international business. The production of goods relies on internationally dispersed supplier networks, and for multinational corporations, this means that environmental responsibility is not limited to their own operations but also extends to suppliers' activities across different countries, regulatory environments, and stages of the value chain. This creates a need for supplier governance mechanisms that allow companies to set expectations, monitor environmental performance, collect environmental data, and support improvements in their supply chains. The thesis examines how Finnish multinational corporations (MNCs) govern environmental sustainability in their supply chains. The focus is on the governance mechanisms used to influence and monitor suppliers' environmental practices, the factors affecting their implementation and potential effectiveness, and the main challenges associated with environmental governance in global supply chains.

The research was conducted as a qualitative multiple-case study by analysing publicly available corporate documents from three large Finnish industrial multinational corporations: KONE, Wärtsilä, and Metso. The empirical material includes sustainability statements, annual reports, supplier codes of conduct, supplier requirements, and other related policy documents. The empirical material was analysed through the study's theoretical framework, which combines stakeholder theory and the resource-based view with earlier literature on supplier environmental governance. The findings suggest that Finnish MNCs govern supplier environmental sustainability through assessment-based and collaborative governance mechanisms. Formal supplier requirements, such as supplier codes of conduct, audits and monitoring systems, form the foundation for governance. These are supported by collaborative mechanisms, including supplier training, dialogue, target-setting, and supplier development. The findings also show that governance mechanisms may be targeted, often focusing on key, high-impact, or high-risk suppliers rather than applying them equally across the whole supply chain. The main implementation challenges relate to supplier data quality, limited visibility into lower-tier suppliers, dependence on supplier capabilities, and the difficulty of translating environmental targets into measurable outcomes. These challenges indicate that formal governance mechanisms do not automatically lead to measurable outcomes and environmental improvements in the supply chain. This study contributes to sustainable supply chain management (SSCM) literature by showing how stakeholder and regulatory pressures, together with internal organisational capabilities, shape environmental governance in global supply chains. The findings of the study also suggest that MNCs should treat supplier data quality, transparency and supplier capability development as central elements of environmental governance rather than only as reporting requirements.

KEYWORDS: SSCM, sustainability, supplier environmental governance, governance mechanisms, supply chain governance

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TIIVISTELMÄ:

Ympäristökestävyys on keskeinen haaste kansainvälisessä liiketoiminnassa, koska tavaroiden tuotanto tapahtuu usein kansainvälisesti hajautuneissa toimittajaverkostoissa. Ympäristövastuu ei rajoitu yrityksen omaan toimintaan, vaan se ulottuu myös toimittajien toimintaan eri maissa, arvoketjun vaiheissa sekä sääntely-ympäristöissä. Tämän vuoksi yritykset tarvitsevat toimittajiin kohdistuvia hallintamekanismeja, joiden avulla ne voivat asettaa toimittajille vaatimuksia sekä tukea toimittajien ympäristökäytäntöjen kehittämistä. Tämän pro gradu -tutkielman tavoitteena on tarkastella, miten suomalaiset monikansalliset yritykset hallitsevat ympäristökestävyyttä globaaleissa toimitusketjuissa. Tutkimuksessa selvitetään, millaisia hallintamekanismeja yritykset käyttävät toimittajiensa ympäristökäytäntöjen ohjaamiseen ja seurantaan. Lisäksi siinä tarkastellaan mekanismien toteuttamiseen ja mahdolliseen vaikuttavuuteen vaikuttavia tekijöitä sekä ympäristön kestävyden hallintaan liittyviä keskeisiä haasteita globaaleissa toimitusketjuissa.

Tutkimus toteutettiin laadullisena monitapaustutkimuksena. Aineistona käytettiin kolmen suuren suomalaisen teollisuusalan monikansallisen yrityksen, KONEen, Wärtsilän ja Metson, julkisesti saatavilla olevia yritysdokumentteja. Aineisto koostui vastuullisuusraporteista, vuosikertomuksista, toimittajien eettisistä ohjeista, toimittajavaatimuksista sekä muista yritysten aiheeseen liittyvistä asiakirjoista. Aineistoa analysoitiin tutkielman teoreettisen viitekehyksen pohjalta. Viitekehys yhdistää sidosryhmäteorian (stakeholder theory), resurssiperustaisen näkemyksen (resource-based view) sekä aiemman tutkimuksen aiheesta. Tutkimustulosten perusteella suomalaiset monikansalliset yritykset ohjaavat toimittajiensa ympäristökäytäntöjä sekä arviointiin että yhteistyöhön perustuvien hallintamekanismien avulla. Hallinnan perustan muodostavat muodolliset vaatimukset, kuten toimittajien eettiset ohjeet, auditoinnit, seuranta ja raportointivaatimukset. Näitä täydentävät yhteistyöhön perustuvat käytännöt, kuten toimittajien koulutus, vuoropuhelu, tavoitteiden asettaminen ja toimittajien kehittäminen. Lisäksi tutkimustulokset osoittavat, että hallintamekanismeja saatetaan kohdentaa erityisesti ympäristövaikutusten ja riskien kannalta keskeisiin toimittajiin. Datan laatu, rajoittunut näkyvyys toimitusketjun alemmille tasoille ja riippuvuus toimittajien kyvykkyydestä ovat keskeisiä haasteita hallintamekanismien toteuttamisessa. Haasteita liittyy myös siihen, miten ympäristötavoitteet saadaan toteutettua käytännössä ja miten niiden tuloksia voidaan mitata. Tutkimus tukee kestäväen toimitusketjun hallinnan kirjallisuutta osoittamalla, että toimittajien ympäristövastuun hallintaan vaikuttavat ulkoisten sidosryhmien ja sääntelyn tuoma paine sekä yrityksen sisäiset kyvykkyydet. Tulokset viittaavat myös siihen, että monikansallisten yritysten tulisi nähdä toimittajadatan laatu, hallinnan läpinäkyvyys ja toimittajien kyvykkyyksien kehittäminen ympäristövastuun hallinnan keskeisinä osina, eikä pelkästään raportointivaatimuksina.

AVAINSANAT: SSCM, sustainability, supplier environmental governance, governance mechanisms, supply chain governance

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1 Introduction

1.1 Background of the study

Organisations are increasingly expected to address sustainability in their activities and operations (Ahi & Searcy, 2013). At the same time, growing demand for goods and increasing consumption place significant pressure on global supply chains and contribute to environmental degradation (Rajeev et al., 2017). Global supply chains play a crucial role in many of the most important environmental issues recognised in the United Nations Sustainable Development Goals (SDGs) (Thorlakson et al., 2018). Environmental impacts often come from different stages of the supply chain rather than from a single company, as production processes are geographically distributed across countries. This has increased expectations for companies to address sustainability issues not only within their own operations but also across their supplier networks. Also, in many cases, lead companies are held responsible for the environmental and social performance of their suppliers, thereby increasing the importance of governance mechanisms that enable companies to influence sustainability practices throughout their supply chains (Seuring & Müller, 2008).

Global supply chains are particularly important for small and open economies like Finland. This is because Finnish multinational corporations (MNCs) operate with broad international networks of suppliers, production sites, and customers (OECD & Statistics Finland, 2020). Finnish MNCs have built their competitiveness on high-quality products, advanced technology, and efficient global operations (Business Finland, 2021). At the same time, these companies face increasing expectations from regulators, investors, customers, and civil society to align their operations with climate and environmental targets (European Commission, n.d.; EFRAG, 2024). For example, several leading Finnish companies have adopted the Science Based Targets Initiative (SBTi), committing to long-term net-zero emissions goals spanning their entire value chains (UN Global Compact Network Finland, n.d.).

The role of sustainability governance in global value chains keeps growing in importance, as sustainability has moved from voluntary corporate social responsibility (CSR) towards more formal and regulatory frameworks (European Commission, n.d.). In the European Union, one of the most significant recent developments is the Corporate Sustainability Reporting Directive (CSRD), which requires large companies to report detailed information on environmental, social, and governance (ESG) matters across their value chains based on the European Sustainability Reporting Standards (ESRS) (European Commission, n.d.; EFRAG, 2024). These regulatory developments, together with climate policies and other due diligence requirements, are expected to strongly influence how multinational corporations manage sustainability issues within their global supply chains. At the same time, the complexity and multi-tier structure of modern supply chains make their governance challenging, as they limit companies' visibility into lower-tier suppliers and their environmental practices (Villena & Gioia, 2020).

1.2 Research problem and gap

Despite increasing regulatory pressure and growing corporate commitment to sustainability, managing environmental practices across global supply chains remains a complex challenge for MNCs. Modern supply chains are often geographically dispersed and involve multiple tiers of suppliers operating in different institutional and regulatory environments (Villena & Gioia, 2020). As a result, lead companies frequently face difficulties in monitoring and influencing sustainability practices beyond their direct organisational boundaries (Seuring & Müller, 2008; Villena & Gioia, 2020). Environmental impacts from production, resource use, and emissions often occur upstream in supplier networks, which makes supply chain governance an important aspect of corporate sustainability strategies (Beske & Seuring, 2014).

To address these challenges, MNCs implement governance mechanisms, such as monitoring systems, supplier codes of conduct, collaborative initiatives, and environmental standards to influence supplier practices (Beske & Seuring, 2014; Gold et al., 2010).

These practices are intended to improve transparency, reduce environmental risks, and align supplier activities with the sustainability objectives of lead companies. However, existing research suggests that implementing sustainability governance across complex global supplier networks remains difficult due to limited supply chain visibility, diverse institutional contexts, and varying supplier capabilities (Villena & Gioia, 2020; Soundararajan et al., 2021).

While sustainability governance has become an important element of supply chain management, there remains a need for a more detailed understanding of how multinational corporations implement environmental governance practices across international supplier networks and what challenges they encounter in doing so. Examining these practices is particularly relevant in the context of multinational corporations, because they operate in globally dispersed supply chains, where sustainability governance must extend beyond the lead company to a wide range of international suppliers. Consequently, there is a need for a better understanding of how multinational corporations implement sustainability governance practices within their global supplier networks. In a changing regulatory environment, understanding how these practices are implemented and what challenges firms encounter is increasingly important for both policymakers and companies.

1.3 Objective of the study and research questions

The objective of this thesis is to examine how multinational corporations govern environmental sustainability within their global supplier networks. The study focuses on the governance mechanisms companies use to influence environmental practices among their suppliers, on the factors that shape implementation and its effectiveness, and on the challenges associated with their application. The thesis analyses sustainability governance practices through publicly available corporate documents of selected Finnish multinational corporations. This study examines how governance mechanisms are communicated and reported in practice through corporate disclosures.

The thesis addresses these objectives by answering the following research questions:

1. How do Finnish multinational corporations govern environmental sustainability within their global supplier networks?
2. What factors explain the implementation and effectiveness of environmental governance mechanisms in global supply chains?
3. What challenges do multinational corporations face when implementing environmental governance practices in global supply chains?

1.4 Key concepts

Global Supply Chain (GSC)

A global supply chain (GSC) refers to a supply structure in which production, sourcing, and distribution activities are managed across multiple countries, linking production sites and suppliers at multiple levels to transfer goods from the source of production to the end customer (Meixell & Gargeya, 2005).

Multinational Corporations (MNCs)

A multinational corporation (MNC) is a company that manages and governs production activities across more than one country. This means the company conducts its operations internationally rather than being active only in a single domestic market. (Caves, 2007, p. 1)

Lead Company

A lead company is a buyer or company that plays a central role in guiding and coordinating suppliers in the supply chain. It can set requirements and monitor suppliers, and influence how they operate. In the literature, lead companies are often referred to as lead firms, but in this study, the term lead company is used most frequently. In this thesis, the

lead companies are the Finnish multinational corporations analysed in the case study. (Humphrey & Schmitz, 2001).

Sustainable Supply Chain Management (SSCM)

Sustainable Supply Chain Management can be defined as “the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social” (Seuring & Müller, 2008, p. 1700).

Supplier Environmental Governance

Supplier environmental governance refers to the regulation and coordination of suppliers’ environmental practices in supply chains through formal and informal instruments such as standards, codes of conduct, monitoring systems, and auditing procedures (Bostrom et al., 2015).

Governance Mechanisms

Governance mechanisms refer to structural arrangements used to influence and regulate the behaviour of organisations within a supply network, including both formal mechanisms such as rules, standards, and procedures and informal mechanisms based on trust, social norms, and relationships (Tachizawa & Wong, 2015).

Environmental Sustainability

Environmental sustainability refers to maintaining the balance and resilience of ecosystems while enabling human societies to meet their needs without exceeding ecological limits or degrading biodiversity (Morelli, 2011).

1.5 The structure of the study

This thesis is structured into seven main chapters. Following the introduction, Chapter 2 presents the literature review, discussing first sustainable global supply chains,

multinational corporations, environmental sustainability in global supply chains and stakeholder and regulatory pressures. Then, the chapter examines supplier environmental governance and the governance mechanisms multinational corporations use to influence environmental supplier practices, including assessment-based and collaborative mechanisms.

Chapter 3 presents the theoretical framework of the study. The framework combines stakeholder theory and the resource-based view to explain why companies implement supplier environmental governance mechanisms, and how internal capabilities influence their implementation. Chapter 4 describes the research methodology, including research design, case selection, data collection and analysis, and the limitations of the research method.

Chapter 5 then presents the case-specific findings from KONE, Wärtsilä, and Metso. Each case is analysed in terms of governance mechanisms, influencing factors, and implementation challenges. Chapter 6 provides a cross-case analysis of the cases, comparing the similarities and differences between each of the case companies. Finally, Chapter 7 presents the conclusions, including key findings, theoretical contributions, practical implications, limitations and suggestions for future research.

2 Literature review

2.1 Global supply chains and multinational corporations

Global supply chains (GSCs) have become a defining feature of modern international business, as production of goods is increasingly dispersed across borders and coordinated through multinational networks. In literature, GSCs are often discussed together with the closely related concept of global value chains (GVCs) (Gereffi & Fernandez-Stark, 2016; Kano et al., 2020). From this perspective, value creation is distributed across different firms and locations, rather than concentrated in a single organisation (Kano et al., 2020). The GVC perspective shifts the focus away from the physical flow of goods to the coordination and governance of economic activities beyond organisational and geographical boundaries (Gereffi & Fernandez-Stark, 2016). As a result, global supply chains can be understood as complex networks of independent actors participating in different stages of production (Coe et al., 2008). This network structure increases the need to coordinate and control activities between firms, making it an important issue in international business research.

Multinational corporations (MNCs) have a central role in coordinating and organising these global production networks (Kano et al., 2020). MNCs operate extensively through geographically dispersed supplier networks, outsourcing activities to independent firms (Kano et al., 2020; Strange & Humphrey, 2019). This reflects a broader shift from hierarchical control towards organisations in which coordination is essential across company boundaries (Buckley & Casson, 2009; Kostova et al., 2016). Recent research shows that this type of organisation makes coordination and governance between companies increasingly important, as firms need to manage complex relationships with multiple suppliers in different countries (Kano et al., 2020). As a result, supply chain management has become a central concern in international business, especially regarding how coordination and control of activities occur beyond a company's organisational boundaries (Strange & Humphrey, 2019).

From an international business perspective, global supply chains are shaped by differences in the institutional environments of countries (Kostova et al., 2016; Mol & Lee, 2024). Companies operating in multiple countries have to navigate different regulatory frameworks, legal systems, governing bodies, and environmental standards that affect both the organisation and governance of supply chain operations (Kostova et al., 2016). These institutional differences create major challenges for maintaining consistent standards across a company's global operations (Mol & Lee, 2024). These challenges are especially relevant in regions with weaker enforcement of regulations or different institutional norms compared to those of the lead company (Mol & Lee, 2024).

2.2 Environmental sustainability in global supply chains

From a global perspective, supply chain emissions and resource use are major challenges related to climate change and biodiversity loss. The Intergovernmental Panel on Climate Change (IPCC, 2023) further highlights the importance of industrial production, resource extraction, and energy use as major sources of greenhouse gas emissions.

Environmental sustainability in global supply chains extends beyond the direct operations of multinational corporations, as a major share of environmental impacts occurs within the supplier networks. Environmental impacts are commonly categorised into Scope 1, 2, and 3 emissions. Scope 1 refers to direct emissions from sources coming from the company's own or controlled operations, and Scope 2 includes indirect emissions from purchased energy (GHG Protocol, n.d.). Scope 3 emissions occur across the value chain, especially in supplier activities (Huang et al., 2009). Studies have estimated that Scope 3 emissions in the supply chain account for the largest share of companies' carbon footprints, Huang et al. (2009) estimating that they can account for upwards of 75%, or more, of the average industry sector's carbon footprint. Previous estimates also indicate that Scope 1 emissions account for only 14% of an industry's carbon footprint and together with Scope 2, only for 26% on average (Huang et al., 2009). Managing these

indirect impacts is important for effective carbon risk assessment and the development of broader corporate climate strategies (Huang et al., 2009; Hettler & Graf-Vlachy, 2024).

While companies have greater control over their internal operations, indirect impacts originating from supplier networks are more complex and difficult to govern (Hettler & Graf-Vlachy, 2024). This is particularly evident in supply chains with multiple tiers, where the lack of contractual relationships between lead companies and lower-tier suppliers is common. This makes these suppliers less visible, which makes it harder to monitor if sustainability standards are followed (Villena & Gioia, 2020). Furthermore, the organisational effort and costs of engaging these distant suppliers create barriers to effective decarbonisation of supply chains (Hettler & Graf-Vlachy, 2024).

Lead companies do not often have the needed transparency into lower-tier suppliers, which makes it difficult to identify potential environmental risks, assess compliance, and influence upstream activities outside of their direct control (Busse et al., 2017; Villena & Gioia, 2020). In this context, direct control of supplier behaviour is often limited, meaning that lead companies have to rely on more indirect forms of influence (Mol & Lee, 2024). The lack of visibility is reinforced by the complexity and fragmentation of GSCs, which are characterised by “finely sliced” value-adding activities distributed across multiple locations and actors (Strange & Humphrey, 2019, p. 579).

Another key issue relates to power asymmetries and misalignment of incentives between MNCs and their suppliers (Strange & Humphrey, 2019; Mol & Lee, 2024). According to Strange and Humphrey (2019), although lead companies may enforce sustainability requirements through codes of conduct, suppliers can operate under time and cost pressures that limit their ability or willingness to prioritise environmental performance over efficiency and survival. These pressures can be particularly relevant for smaller suppliers in developing countries (Strange & Humphrey, 2019; Soundararajan et al., 2018). They may also contribute to “supplier opportunism”, where suppliers intentionally decouple actual practices from the lead company’s policies (Mol & Lee, 2024, p. 584). This

can create trade-offs between environmental and economic objectives, as sustainability requirements may be viewed as additional costs that conflict with other priorities such as cost reduction and delivery speed (Mol & Lee, 2024).

From an international business perspective, these challenges are magnified by differences in institutional environments in different countries. Regulatory frameworks, enforcement mechanisms and societal expectations regarding environmental responsibility can vary between regions. This creates an “institutional distance” that often causes a gap between the lead company’s sustainability policies and suppliers’ actual practices (Mol & Lee, 2024). In many emerging economies, formal institutions may be weaker, creating an environment in which multinational companies operate in which local practices and enforcement conditions differ from international sustainability standards (Soundararajan et al., 2018; Villena & Gioia, 2020). As a consequence, companies must navigate both institutional diversity and organisational complexity when addressing environmental sustainability. These conditions can increase information asymmetries and make governance more costly and difficult for lead companies (Mol & Lee, 2024; Soundararajan et al., 2018).

These challenges force companies to influence environmental activities outside of their direct control. This has increased the importance of governance and coordination mechanisms that enable companies to monitor, enforce and support sustainability practices across supply chains (Kano et al., 2020). Effective governance requires a combination of formal contracts and informal cooperation, grounded in trust, to address institutional gaps and ensure the effective implementation of sustainability standards (Mol & Lee, 2024; Strange & Humphrey, 2019).

Stakeholder expectations regarding environmental responsibility have also increased in recent years, as investors and other stakeholders evaluate companies based on climate risk exposure and sustainability performance (Khan et al., 2016). Regulatory pressures have also intensified through European frameworks such as the Corporate Sustainability

Reporting Directive (CSRD), which strengthens requirements for companies to report sustainability impacts, risks and opportunities, including information from the value chain (European Commission, n.d.). Together, these developments create strong incentives for MNCs to improve sustainability governance in their supply chains.

2.3 Stakeholder and regulatory pressure

Companies face growing external pressure to address environmental sustainability throughout their supply chains. These pressures come from different stakeholder groups, such as regulators, investors, and customers, who demand greater accountability for environmental impacts across the value chain (Marculetiu et al., 2023; Busse et al., 2017). In GSCs, this extends corporate responsibility for the entire supply chain beyond internal operations (Busse et al., 2017; Vidal et al., 2023).

Market-based pressures from customers and investors are major drivers of this shift. Customers and end-users place growing emphasis on sustainability, which encourages firms to adopt environmentally responsible practices in their supplier networks (Marculetiu et al., 2023; Vidal et al., 2023). At the same time, investors have incorporated environmental, social, and governance (ESG) criteria more systematically into their decision-making, thereby pressuring firms to improve sustainability risk management (Vidal et al., 2023). ESG reporting and transparency have also become more important for companies, especially as supply chain emissions receive more attention (Hettler & Graf-Vlachy, 2024).

In addition to the market, non-governmental organisations (NGOs) and civil society actors also influence companies by monitoring corporate behaviour and raising public attention to sustainability issues (Marculetiu et al., 2023). NGOs can also increase reputational risks for firms, especially when environmental or social problems occur upstream in supplier networks, with limited visibility to lead companies (Busse et al., 2017). Regulatory pressure has also expanded significantly and become a stronger driver of

corporate sustainability disclosure, especially as companies are expected to provide more detailed information on their value chains (Hettler & Graf-Vlachy, 2024). Governments and international organisations are introducing legislation that requires firms to take more responsibility for impacts linked to their supply chains (Marculetiu et al., 2023).

In the European Union, the Corporate Sustainability Reporting Directive (CSRD) has expanded sustainability reporting requirements by requiring large and listed companies to disclose information on social, environmental and governance matters, including value chain information in accordance with the European Sustainability Reporting Standards (ESRS) (European Commission, n.d.; EFRAG, 2024). In addition to CSRD, the Corporate Sustainability Due Diligence Directive (CSDDD), which entered into force on 25 July 2024, requires large EU-wide companies to identify and address human rights and environmental impacts in their operations and global value chains (European Parliament & Council of the European Union, 2024). However, the regulatory landscape is constantly evolving, as the EU's Omnibus amendments postponed the CSRD reporting for some companies and delayed the first application of the CSDDD by one year (European Commission, 2025). These developments represent a broader shift from voluntary commitments to sustainability toward formalised accountability. According to Truant et al. (2024), ESG issues in supply chains are shifting from surface-level compliance toward more integrated business models, where ESG principles become part of the company's value creation and supply chain transparency.

2.4 Supplier environmental governance

In this thesis, supplier environmental governance refers to the regulation and coordination of suppliers' environmental practices in global supply chains through different formal and informal instruments, such as standards, codes of conduct, monitoring systems, and auditing procedures (Boström et al., 2015). This concept builds on broader literature on Sustainable Supply Chain Management (SSCM), which emphasises the integration of environmental considerations into supply chain activities (Seuring & Müller, 2008;

Formentini & Taticchi, 2016). Within the related fields of SSCM and Green Supply Chain Management (GSCM), governance enables the translation of corporate sustainability goals into actual operational practices (Formentini & Taticchi, 2016; Koberg & Longoni, 2019).

A combination of internal governance structures, external regulatory and stakeholder pressures drives the implementation of supplier environmental governance. Ludwig and Sassen (2022) highlight that, internally, the board of directors plays a major role in integrating sustainability into corporate governance. Other internal mechanisms, such as board independence, diversity, and sustainability committees, can also support sustainable strategies and effective governance of climate-related risks (Ludwig & Sassen, 2022). Furthermore, the internal sustainability orientation and organisational values of a company provide an incentive for integrating an environmental perspective into strategic planning and supplier selection (Formentini & Taticchi, 2016; Vidal et al., 2023).

External regulatory pressure has become one of the strongest factors driving corporate accountability in the European Union. The CSRD and CSDDD expand corporate accountability by requiring firms to report sustainability information from value chains (European Commission, n.d.). Beyond regulation, reputational risk also matters for companies, as NGOs and media can monitor corporate behaviour and expose environmental misconduct (Soundararajan et al., 2019). However, Koberg and Longoni (2019) note that relying only on standards does not necessarily produce evidence of actual improvement. Hence, the internal governance structure and processes are important, even though the EU sets direct requirements for companies in the European Union.

Although academic research provides many models for sustainable supply chains, these models often remain difficult to implement and verify in practice (Formentini & Taticchi, 2016; Hettler & Graf-Vlachy, 2024). This can result in decoupling, in which companies formally adopt standards while actual practices may remain unchanged (Soundararajan et al., 2019; Mol & Lee, 2024). Additionally, corporate reporting is often selective, as

companies may highlight positive information while leaving details out on negative environmental data (Hettler & Graf-Vlachy, 2024).

Managing and governing global supply chains is challenging due to their organisationally and geographically dispersed nature. MNCs often lack visibility into lower-tier operations. Lead companies act as the coordinators of GSCs, relying on indirect influence and a combination of formal and informal governance mechanisms to guide sustainability practices in their supplier networks (Koberg & Longoni, 2019). These governance mechanisms can be categorised into two approaches: **assessment-based approaches**, with a focus on compliance through monitoring, auditing and standards, and **collaborative approaches**, focusing on capacity building and trust-based cooperation for long-term development (Koberg & Longoni, 2019). The following sections examine these governance mechanisms, the factors influencing their implementation and effectiveness, and the challenges firms face in practice.

2.5 Governance mechanisms in global supply chains

Companies rely on a diverse set of governance mechanisms to influence and manage environmental sustainability within their supply chains. These mechanisms are essential because MNCs usually lack direct hierarchical control over supplier activities outside their organisational boundaries. Prior research suggests that supplier environmental governance involves different types of mechanisms that vary in levels of control and intensity (Formentini & Taticchi, 2016; Koberg & Longoni, 2019; Bonatto et al., 2022). In this study, the governance mechanisms are categorised into two main approaches mentioned earlier: assessment-based and collaborative approaches (Koberg & Longoni, 2019). This categorisation demonstrates the distinction between control-based practices and relational governance practices (Koberg & Longoni, 2019). While assessment is often the starting point for supplier governance in global settings, academic literature suggests that collaboration is also needed to address shortcomings in sustainability performance and support more substantive sustainability outcomes (Koberg & Longoni, 2019).

From a theoretical perspective, governance can be separated into two different forms, which are contractual and relational forms (Bonatto et al., 2022). Contractual governance is rooted in Transaction Cost Theory (TCT) and relies on formal rules and legal safeguards to protect against partner opportunism (Bonatto et al., 2022). In contrast, relational governance draws on Social Exchange Theory (SET) and Relational Exchange Theory (RET), highlighting the role of mutual trust and informal norms, such as flexibility and solidarity (Bonatto et al., 2022). In practice, these theoretical perspectives can be operationalised through two main approaches used in this study: assessment-based mechanisms, which reflect contractual logic, and collaborative mechanisms, which reflect relational logic (Koberg & Longoni, 2019; Amiri, 2026). While these two approaches have traditionally been viewed as distinct, more recent research suggests that they are complementary: formal contracts specify roles in stable environments, while relational norms provide the needed flexibility to adapt to changing circumstances (Koberg & Longoni, 2019; Bonatto et al., 2022).

According to Bonatto et al. (2022), the selection and effectiveness of these mechanisms are influenced by seven key contextual factors: relationship history, environmental uncertainty, perceived risk, perceived justice, asset specificity, power asymmetry, and interdependence. For example, a positive relationship history can make relational governance more viable, because past experiences help companies assess how partners are likely to behave in the future (Bonatto et al., 2022).

2.5.1 Assessment-based mechanisms

Assessment-based mechanisms refer to different formal governance tools that lead companies can use to evaluate, monitor and enforce supplier compliance with set standards (Formentini & Taticchi, 2016; Koberg & Longoni, 2019). These mechanisms are mostly control-oriented and rely on contractual power to ensure minimum supplier compliance with sustainability requirements (Bonatto et al., 2022). Typical assessment mechanisms

include supplier codes of conduct, contractual sustainability clauses, third-party certifications, and environmental audits (Soundararajan et al., 2019; Marttinen et al., 2024). In theory, through these tools, companies can systematically track indicators of environmental performance and identify potential climate-related risks in their supply chain networks, although they do not always lead to expected outcomes (Soundararajan et al., 2019).

Amiri (2026) states in his study on managing supplier relationships that the assessment-based approach typically consists of three elements: a standard, a monitoring process, and an enforcement mechanism. The standards can be supplier codes of conduct developed by the lead firm, or they could be public standards like ISO standards developed by third parties (Amiri, 2026). Monitoring often takes place through audits conducted by third-party audit providers or lead firm employees, and enforcement is based on reward and sanction systems included in contracts (Amiri, 2026).

Prior research has identified limitations with only relying on assessment-based governance mechanisms, especially in global supply chains. Vidal et al. (2023) refer to previous research estimating that up to 93% of supply chain activities may remain invisible to lead companies, making the identification of misconduct difficult. Audits and reporting systems can also be affected by supplier opportunism and information asymmetries, as suppliers may violate policies while hiding non-compliant practices to avoid penalties from the monitoring bodies (Mol & Lee, 2024). The lack of transparency can lead to poor quality of data, as firms may emphasise positive climate-related information and withhold negative data (Hettler & Graf-Vlachy, 2024).

Assessment-based approaches may promote more symbolic compliance, rather than substantive compliance, resulting in a “tick-box” approach to sustainability (Soundararajan et al., 2019). In such cases, suppliers may engage in evasive work or decoupling, where they formally comply with standards, while their operations continue to diverge from the buyer’s expectations (Soundararajan et al., 2019). Because of these weaknesses,

literature suggests that assessment alone is often not enough for solving environmental issues and should be accompanied by collaborative strategies to achieve actual improvements (Formentini & Taticchi, 2016; Koberg & Longoni, 2019).

2.5.2 Collaborative mechanisms

Collaboration is identified as one of the most important capabilities that companies can use to manage issues in supply chains (Klassen & Vereecke, 2012). Contrary to assessment-based approaches, collaborative mechanisms focus on building long-term relationships and improving suppliers' capabilities to meet environmental standards. These mechanisms represent the relational dimension of SSCM, where communication, knowledge sharing, and supplier support are used to improve environmental practices (Koberg & Longoni, 2019). This reflects relational governance where trust and informal norms can reduce reliance on authoritative control (Bonatto et al., 2022). Mutual trust can also help buyers and suppliers work towards shared environmental goals (Bonatto et al., 2022).

Collaborative governance practices include supplier development programs, training initiatives, technical assistance, and financial support aimed at improving environmental performance (Koberg & Longoni, 2019; Marttinen et al., 2024). These practices address performance shortcomings and the root causes of sustainability challenges rather than relying only on formal compliance (Koberg & Longoni, 2019). While assessment is often a starting point, collaboration is important for achieving more substantive environmental outcomes (Koberg & Longoni, 2019). Effective collaboration also allows lead firms to use social mechanisms, such as knowledge sharing and capability development, to support sustainability improvements in the supply chain (Kano et al., 2020).

Collaboration is especially important in GSCs, where suppliers may lack the resources and technical expertise needed to implement environmental improvements (Koberg & Longoni, 2019). Institutional distance can lead to a further gap between the lead

company's policies and suppliers' practices (Mol & Lee, 2024). By engaging in joint initiatives and supplier support, lead companies can help suppliers to internalise environmentally responsible practices and address some of the limitations of local operating conditions (Mol & Lee, 2024).

Collaborative approaches also involve challenges despite their benefits, as they often require time and resources from lead companies (Koberg & Longoni, 2019; Amiri, 2026). Their effectiveness also depends on the willingness and ability of suppliers to engage in these activities, as suppliers may be reluctant to share information if they fear losing their position in the supply chain (Busse et al., 2017). Power imbalances and cost pressures can also limit collaboration, especially if lead companies demand compliance while suppliers face limited resources or pressure to reduce costs (Bonatto et al., 2022).

3 Theoretical framework

This study develops a theoretical framework to explain how MNCs govern environmental sustainability in global supply chains and what factors influence the implementation of these governance practices. Stakeholder theory is used to explain the external pressures that encourage companies to adopt supplier environmental governance, and the resource-based view (RBV) helps to explain how internal capabilities affect implementation. The framework also considers the supply chain context of global supply chains, including institutional distance, supply chain complexity and supplier capabilities.

3.1 Stakeholder theory

Stakeholder theory suggests that companies must consider the interests and expectations of all stakeholders who can affect or are affected by the firm's activities (Freeman, 1984). In the context of global supply chains and environmental sustainability, relevant stakeholders include regulators, investors, customers, suppliers, NGOs, and local communities (Saleem et al., 2020). From this perspective, these stakeholders exert increasing pressure on firms to address environmental sustainability in their operations and across their supplier networks. Although suppliers can also be understood as stakeholders, this thesis analyses them primarily as governed actors and implementation partners, because the focus is on how lead companies define supplier requirements, monitor performance and collaborate with suppliers. Sustainability policies such as supplier codes of conduct, climate targets, and environmental reporting frameworks can thus be understood as tools through which firms respond to stakeholder pressures and manage their legitimacy in society. Recent studies find that investors increasingly pay attention to supply chain transparency and Scope 3 emissions (Busch et al., 2022). The EU's CSRD and CSDDD frameworks influence corporate sustainability behaviour by mandating disclosure and due diligence requirements (European Commission, n.d.; European Parliament & Council of the European Union, 2024). According to Knudsen and Moon (2017),

regulatory frameworks can shape corporate policies by creating both normative and institutional pressure.

3.2 Resource-based view

While stakeholder theory helps explain why firms adopt sustainability governance practices, it does not fully explain why companies differ in how these practices are implemented. The resource-based view (RBV) provides a complementary perspective. The RBV is a strategic management theory that helps explain how internal resources and capabilities influence a company's ability to implement sustainability policies effectively. According to Barney (1991), firms can achieve a competitive advantage when they possess valuable, rare, inimitable, and non-substitutable (VRIN) resources. In the context of sustainable supply chain management, these resources frequently take the form of knowledge, relationships, processes, and technological systems that enable environmental improvements. Hart (1995) argued that firms with strong environmental capabilities are better able to reduce resource use and environmental impacts. More recent studies also show that internal capabilities influence how supply chain policies are implemented and translated into practice (Longoni & Cagliano, 2018).

3.3 Integrated theoretical framework

Building on these perspectives, this thesis develops an integrated framework for analysing supplier environmental governance in global supply chains. Stakeholder theory is used to explain the external drivers that encourage companies to adopt environmental governance mechanisms. These drivers include stakeholder pressures from investors, customers, NGOs and civil society (Freeman, 1984; Khan et al., 2016), as well as regulatory pressures created by regulatory frameworks like CSRD and CSDDD (European Commission, n.d.; European Parliament & Council of the European Union, 2024). At the same time, RBV helps explain how internal capabilities affect the implementation of these

practices. In this thesis, relevant capabilities include internal management systems, infrastructure for supplier data, procurement processes, sustainability expertise and supplier engagement practices (Barney, 1991; Hart, 1995; Longoni & Cagliano, 2018).

Governance mechanisms are understood as practices companies use to influence suppliers' environmental actions. These mechanisms are examined in this thesis through assessment-based and collaborative approaches (Koberg & Longoni, 2019). The framework also separates external drivers from the implementation context. Regulatory pressure and institutional distance are related to each other, but they are treated as analytically distinct. Formal requirements for companies to develop their supplier governance are viewed as regulatory pressures, while institutional distance refers to differences in norms, regulatory enforcement, and operating conditions in supplier countries (Mol & Lee, 2024). The implementation context also includes supply chain complexity and supplier capabilities, which can affect how governance mechanisms are applied in practice (Villena & Gioia, 2020).

Based on these theoretical perspectives, the empirical analysis examines how external drivers and internal capabilities shape supplier environmental governance mechanisms, how these mechanisms are reported to be implemented, and what challenges companies encounter in practice. Because the empirical data are based on publicly available corporate documents, the framework uses the terms “reported implementation” and “potential effectiveness”. The theoretical framework of this thesis is illustrated in Figure 1. Based on this framework, the empirical analysis examines (RQ1) the governance mechanisms used by companies, (RQ2) the factors shaping their reported implementation and effectiveness, and (RQ3) the challenges encountered in practice.

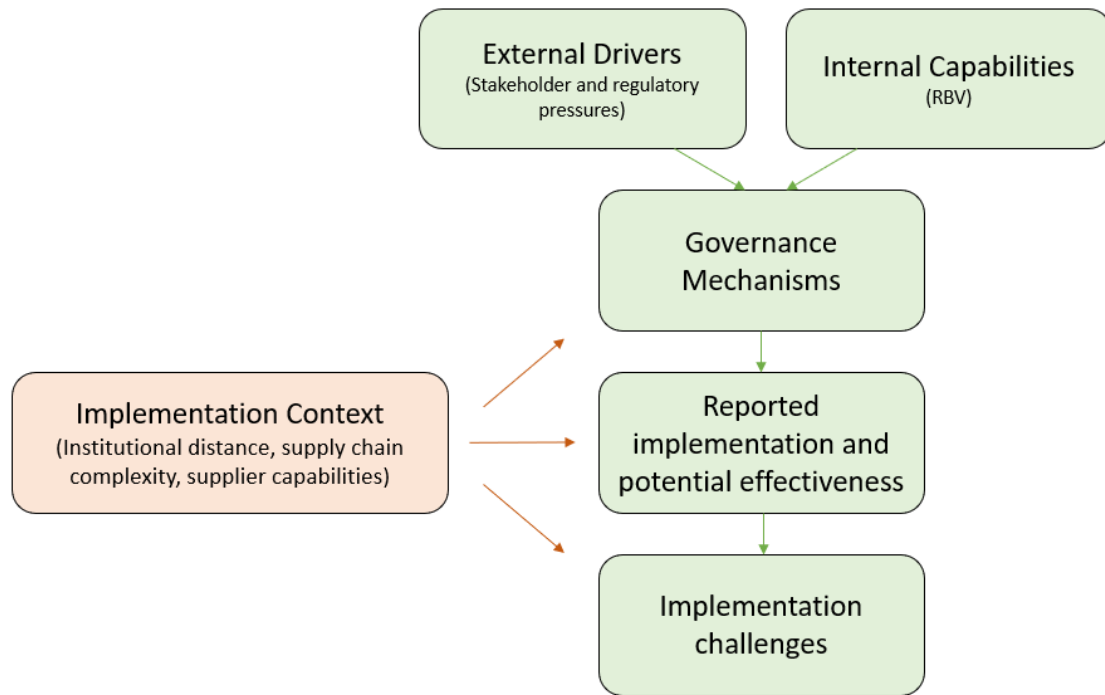


Figure 1. Theoretical framework of supplier environmental governance in global supply chains

4 Methodology

4.1 Research design

Research designs are commonly categorised into qualitative, quantitative, and mixed-method approaches (Saunders et al., 2023). This study adopts a qualitative research approach to examine how multinational corporations govern environmental sustainability within their global supply chains, what factors influence governance, and what challenges these companies face. Qualitative research is appropriate for studying complex organisational phenomena and processes in context, especially when the aim is to generate deep understanding instead of statistical generalisation (Saunders et al., 2023).

The research is designed as a multiple case study, focusing on three Finnish multinational corporations operating in international supplier networks. A case study is suitable for this thesis because it enables an in-depth examination of a phenomenon within its real-life organisational context (Saunders et al., 2023). This is relevant for supplier environmental governance, as the phenomenon cannot be fully separated from the company context, supply chain structure, regulatory environment and available corporate disclosures. A multiple case study design also enables comparison between cases and helps identify whether similar patterns appear across different companies (Saunders et al., 2023).

Previous studies on sustainability reporting have often used large samples to identify broad disclosure patterns, but such approaches generally prioritise breadth over detailed analysis of how governance practises are reported and structured in specific organisations (Hahn & Kühnen, 2013; Christensen et al., 2021). This is important for the topic of this thesis, as the implementation of governance mechanisms is connected to specific supply chain structures, reporting systems and supplier relationships.

More recent research suggests that the literature remains fragmented, specifically about the governance of complex environmental issues within supply chains, where broad

findings may not fully capture the nuances of reported implementation in specific organisational and supply chain contexts (Villena & Gioia, 2020; Hettler & Graf-Vlachy, 2024). Thus, this study adopts a more focused multiple case approach by analysing a limited number of cases in depth. This allows for a more detailed examination of reported governance mechanisms, the factors influencing their implementation, and their potential effectiveness.

4.2 Case selection

The case companies were selected using purposive sampling, which is commonly used in qualitative research to identify information-rich cases relevant to the research objective (Saunders et al., 2023). Contrary to statistical sampling methods, there is no one specific rule regarding the minimum number of studied cases that must be selected for a multiple-case study (Eriksson & Kovalainen, 2008, p. 124). Patton (1990, as cited in Eriksson & Kovalainen, 2008, p. 124) describes that cases can be sampled by “critical case sampling”, which looks for cases representing the most “critical or relevant” cases for the research purpose. The selection of the case companies for this study is justified by their relevance in relation to the chosen predefined selection criteria, which were:

1. Large Finnish multinational corporations operating in global supply chains.
2. Availability of comprehensive sustainability disclosures.
3. Relevance to supplier environmental governance.

A small number of cases were selected for more in-depth analysis and meaningful cross-case comparison. Eisenhardt (1989) suggests restricting the number of cases to the extent that the additional contribution of more cases is only minimal. All selected cases are Finnish MNCs operating in industrial sectors, but differences in business areas and supply chain features were intentionally included to facilitate a more substantial comparison among the cases.

4.3 Data collection

The empirical data of this study consists of publicly available corporate documents, including sustainability reports, annual reports, supplier codes of conduct, and other ESG-related disclosures of the selected Finnish multinational corporations. Non-technical literature, such as corporate documents, “is a potential source of empirical data for case studies” (Bowen, 2009, p. 29).

More specifically, the data set for each case company includes sustainability reports, annual reports, and supplier-related policy documents, such as supplier codes of conduct, to support comparability. See Table 1 for the specific documents analysed for each of the case companies. The most recently published versions of these corporate documents were used to ensure that the analysis reflects the most recent available information. For qualitative business research, secondary data from texts often provide excellent opportunities for research (Eriksson & Kovalainen, 2008, p. 89). The use of document-based data is well established in qualitative research. Document analysis provides a systematic procedure for reviewing and evaluating documents as sources of empirical data, allowing researchers to examine organisational practices, policies, and strategies (Bowen, 2009).

Table 1. Selected case companies

Company	Documents analysed	Reference
KONE	<ul style="list-style-type: none"> - Sustainability Statement 2025 - Sustainability Supplement 2025 - Supplier Code of Conduct - Code of Conduct 	KONE (2026a) KONE (2026b) KONE (2025a) KONE (2024)
Wärtsilä	<ul style="list-style-type: none"> - Annual Report 2025 - Supplier Requirements - Supplier Handbook - Code of Conduct 	Wärtsilä (2026) Wärtsilä (2021) Wärtsilä (n.d.) Wärtsilä (2025)
Metso	<ul style="list-style-type: none"> - Annual Report 2025 - Sustainability Statement 2025 - Supplier Code of Conduct - Code of Conduct 	Metso (2026b) Metso (2026a) Metso (2024) Metso (n.d.)

Annual reports by companies are considered an “important source of information for business research” (Eriksson & Kovalainen, 2008, p. 102). Sustainability disclosures are also relevant for this study because they provide information on firms’ environmental practices and governance mechanisms. Previous research suggests that sustainability reporting provides information for stakeholders and reflects firms’ environmental activities and priorities (Christensen et al., 2021; Hummel & Schlick, 2016). Furthermore, sustainability reports serve as a communication channel through which companies disclose their environmental strategies, supply chain policies, and governance mechanisms (Hahn & Kühnen, 2013).

The use of sustainability reports and other corporate documents as empirical material is supported by previous research using content analysis in corporate sustainability research. Landrum and Ohsowski (2018) analysed corporate sustainability reports to investigate how companies construct different understandings of sustainability, demonstrating that company reports can also be used to interpret how companies frame sustainability priorities and responsibilities. Similarly, Kassier (2024) used qualitative content analysis to examine transitions in sustainability reporting among MNCs. Supplier codes of conduct and other policy documents are relevant for this study, as they formalise the expectations placed by the lead companies on their suppliers. Vandenbroucke et al. (2024) demonstrate that supplier codes of conduct can be systematically analysed as corporate self-regulating documents using manual coding and text-as-data approaches. Similarly, Vörösmarty (2026) uses supplier codes of conduct to examine them as governance and transparency tools for supply chains.

4.4 Data analysis

The data analysis in this research follows a primarily deductive content analysis approach. Deductive content analysis is appropriate when the analysis is guided by existing theoretical frameworks and prior research (Elo & Kyngäs, 2008). This suits the purpose of this study, because the coding framework is based on the theoretical framework and

previous literature on supplier environmental governance. Content analysis enables systematic and objective analysis of documents by categorising and structuring data into meaningful themes (Krippendorff, 2019).

In this study, the coding framework is derived from the literature on sustainable supply chain management and supplier governance, particularly the distinction between assessment-based and collaborative governance mechanisms, as well as identified influencing factors and implementation challenges. For example, statements referring to supplier requirements, codes of conduct, audits and monitoring were coded as assessment-based governance mechanisms, whereas references to supplier development programs, training initiatives, and technical assistance were coded as collaborative mechanisms.

The approach to the analysis followed primarily the deductive content analysis approach presented by Elo and Kyngäs (2008, p. 110), with inductive elements, as coding was partly open to leave space for emerging topics and other interesting observations. The analysis followed a structured manual coding process where, first, all documents were read in full to get an overview of each company's sustainability governance and identify sections relevant to supplier environmental governance. Second, relevant segments of the text were extracted and coded into an Excel sheet using a deductive coding framework presented in Appendix 1. Each extracted passage included the case company, document name, page number, code, and analytical note to allow tracing back to the specific source. This created an audit trail between the findings and the analysed documents. The coding framework was based on the theoretical framework, literature review, and research questions. Codes related to governance mechanisms included supplier codes of conduct, audits and monitoring, reporting requirements, supplier selection and enforcement, supplier development, capacity building and information sharing. Codes related to influencing factors included internal capabilities, regulatory and stakeholder pressure, and supply chain complexity. Codes related to implementation challenges included data limitations, indirect control, limited visibility and implementation gaps. Relevant segments were also coded as emerging observations if the quoted passage could

not be defined by a specific code. Third, the coded data were analysed within each case to identify governance patterns within each company. Finally, the cases were compared across the same coding categories to identify similarities, differences and broader cross-case characteristics.

While the analysis is primarily deductive, it also allows for the identification of emerging themes. This combination of deductive and inductive elements is common in qualitative research and enables both theory-driven analysis and sensitivity to empirical insights (Elo & Kyngäs, 2008). In case studies, unexpected patterns might become evident during the research (Eriksson & Kovalainen, 2008, p. 127).

4.5 Limitations

While document analysis provides rich and accessible data, it is important to acknowledge its limitations. Corporate sustainability disclosures may not fully reflect actual practices, as firms can engage in selective reporting and impression management (Michelon et al., 2015; Bingler et al., 2022). This limitation is particularly relevant in sustainability research, where companies face reputational and regulatory pressure to present themselves as environmentally responsible. Lock and Seele (2016) similarly argue that the credibility of CSR reports cannot be taken for granted. Because the study relies on public corporate documents, the findings reflect reported governance practices rather than verified implementation or actual outcomes on the supplier level. The analysis can identify how companies describe their structures and communicate their supplier environmental governance, but it cannot confirm whether these mechanisms are always implemented in practice, or if they lead to measurable environmental improvements among suppliers. This limitation is especially relevant regarding collaborative mechanisms, as reports often mention engagement and setting targets, but provide limited evidence on supplier-level outcomes.

Document analysis itself is not always advantageous, as there are some fundamental limitations. Bowen (2009) states that documents are produced for purposes other than research, and they may be insufficient in detail. Also, in an organisational context, selected documents can be aligned with specific corporate procedures and policies according to the interests of their producers (Bowen, 2009). However, Bowen (2009, p. 32) describes these issues as “potential flaws”, rather than substantial disadvantages, as the advantages of document analysis can outweigh the limitations.

5 Findings

This chapter presents the empirical findings of the study. The findings are based on the analysed corporate documents and should be understood as interpretations of reported governance practices instead of direct evidence of supplier-level practices. Each case is discussed using the same structure, where first, governance mechanisms are discussed, then influencing factors, and finally, implementation challenges. This structure keeps the findings connected to the research questions and to the theoretical framework. References to the analysed company documents are included throughout the chapter to present an empirical basis for interpretations and to maintain transparency between the analysed material and findings.

5.1 KONE

5.1.1 Governance mechanisms

KONE's supplier environmental governance is mainly based on formal compliance mechanisms. This is done especially through its Supplier Code of Conduct (KONE, 2025a). The Supplier Code of Conduct establishes different environmental and social expectations that suppliers must comply with as a condition for a business relationship. These include compliance with environmental legislation, regulations, and international standards, although the degree of specificity varies between different requirements. The expectations for suppliers are further defined through additional contractual components, such as the Environmental Annex, which outlines more detailed obligations for "key suppliers" (KONE, 2026a). This also suggests a selective governance mechanism. For example, KONE requires suppliers to comply with environmental standards such as ISO 14001 (KONE, 2026a). However, the Environmental Annex does not appear to be a public document, but is only available for suppliers and personnel of KONE (2026a). Because it is not publicly available, the exact requirements for suppliers cannot be fully assessed from public

documents. Overall, the Supplier Code of Conduct and the Environmental Annex indicate formal environmental compliance requirements for suppliers.

KONE also relies on different monitoring and assessment mechanisms to supervise the environmental performance of suppliers. These include supplier screenings and audits (KONE, 2026a), annual Supplier Sustainability assessment (KONE, 2026b), and risk-based monitoring systems (KONE, 2026a; KONE, 2025a). This is supported by progress monitoring through different key performance indicators (KPIs), such as “material emissions... the share of recycled content... and the share of material spend” (KONE, 2026b, p. 19). These multiple measures show a structured approach to supplier governance, but they appear to be mainly applied to targeted suppliers. This is shown in the annual Sustainability Assessment, which “evaluates 100% of the targeted suppliers” (KONE, 2026b). KONE also states that it “engages closely with its 200 largest material suppliers, who account for approximately 75% of total purchase spend” (KONE, 2026b, p. 18). This supports the interpretation that KONE uses a selective governance approach. KONE also applies a risk-based approach for supplier governance, as the suppliers are evaluated based on factors such as geographic location, materials and associated risks with the supply chain (KONE, 2026a).

Supplier reporting also emerges from the collected data as an important part of governance for KONE. Suppliers are expected to be able to provide environmental data from: “emissions reduction and reporting according to GHG protocol..., ability to provide data for Environmental Product Declarations, Carbon Border Adjustment Mechanism (CBAM) reporting and regulatory compliance..., and participation and engagement in sustainability training programs” (KONE, 2026b, p. 18). These results are gathered into “Supplier Sustainability Scorecards” supported by onsite visits, if necessary, and the information is used as an input for purchasing decisions. These measures suggest that KONE sets reporting requirements for suppliers, and uses assessment methods for evaluating suppliers.

As stated on KONE's webpage on the Environmental Policy Statement of KONE, they "cut greenhouse gas emissions and air pollution in operations and across the value chain, by engaging suppliers in emissions reductions and material efficiency" (KONE, 2025b). In addition to control- and risk-based mechanisms, KONE also reports collaborative approaches targeted to improve the environmental performance of suppliers. These include training initiatives (KONE, 2026b), joint development activities and continuous dialogue through workshops, meetings and other platforms (KONE, 2026a). KONE works with selected suppliers to set emission reduction targets, develop corrective action plans, and explore solutions, such as low-carbon materials and circular practices (KONE, 2026a). KONE also provides guidance on international standards and supports implementation with monitoring through assessments (KONE, 2026b). These measures indicate that suppliers are not only subject to monitoring, but they are also supported in developing environmental capabilities.

5.1.2 Influencing factors

KONE has established dedicated organisational structures, including a supplier sustainability team, which operates in coordination with functions such as "Global Sustainability, Ethics and Compliance and Purchasing teams" (KONE, 2026b, p. 18). According to the sustainability statement, sustainability governance is embedded at the highest organisational level, as the responsibility is shared across key governing bodies, including the Board of Directors and executive level committees (KONE, 2026a). KONE also reports internal systems for monitoring, reporting and validating supplier-related data, which supports a structured governance approach (KONE, 2026a). Furthermore, sustainability targets are integrated into performance management systems, indicating that governance processes are connected to organisational processes and not treated as separate initiatives (KONE, 2026b).

KONE's approach is guided by regulatory frameworks such as the CSRD, related reporting standards such as ESRS (KONE, 2026a), and voluntary reporting standards such as GRI

(KONE, 2026b). These frameworks drive the need for structured and comparable data collection. However, these standards do not directly determine governance practices but are translated into internal systems and processes. The findings also indicate that stakeholder expectations shape sustainability priorities, as KONE engages with a wide range of stakeholders, "...including, but not limited to, customers, shareholders, employees, suppliers and equipment users..." (KONE, 2026a, p. 36).

KONE operates within "over 60 countries and collaborates with partners in close to 100 countries" (KONE, 2026b, p. 86). A significant share of environmental impacts, especially Scope 3 emissions, originates from activities outside of KONE's direct control, limiting the extent to which KONE can directly enforce environmental practices (KONE, 2026a). KONE addresses this partly by collaborating with key suppliers and exploring new energy solutions directly in the countries where the products are deployed (KONE, 2026a, p. 64). This suggests that KONE seems to understand the importance of collaboration in addressing Scope 3 emissions, but the available documents provide limited amount of concrete examples for these practices.

5.1.3 Implementation challenges

The findings show several challenges and limitations with supplier environmental governance at KONE. A key challenge relates to limited visibility across the supplier base, as KONE faces data availability constraints (KONE, 2026a). Even though KONE has established a structured monitoring and screening system for suppliers, the full extent of coverage remains unclear (KONE, 2026b). Findings indicate that environmental data collection relies partly on manual processes, estimations, and the use of secondary data sources, when primary data is not available (KONE, 2026a). This creates uncertainty into reported environmental data and metrics, which can limit the accuracy of sustainability assessments.

The findings from the data also indicate an implementation gap between governance expectations and practical outcomes. While KONE establishes clear environmental requirements and targets, their implementation is influenced by external factors outside of the company's direct control. The pace of decarbonisation in upstream industries and the readiness of suppliers to adopt sustainability practices affect which governance objectives can be achieved (KONE, 2026a). KONE notes that it does not mandate SBTi participation, as “many steelmakers... face technological and industry constraints” (KONE, 2026b, p. 19). This shows the difficulty of governing environmental sustainability in global supply chains, as the outcome can depend on broader industry dynamics and supplier engagement, instead of only depending on the lead company's governance mechanisms.

5.2 Wärtsilä

5.2.1 Governance mechanisms

Wärtsilä's supplier environmental governance is structured around different formal compliance requirements, monitoring systems, and supplier development practices. Formal governance practices are established through Wärtsilä's Supplier Requirements (2021), Code of Conduct (2025), and Supplier Handbook (n.d.), which define environmental expectations and requirements for suppliers. These include compliance with environmental legislation and regulations, as well as material restrictions (Wärtsilä, 2021). In Wärtsilä's annual report, it is stated that the publicly available Supplier Requirements “apply to all suppliers”, and the implementation is carried out by Corporate Supply Management (Wärtsilä, 2026, p. 127). Also, the Code of Conduct states that “similar principles of ethical business behaviour as reflected in the Code” are expected from suppliers (Wärtsilä, 2025, p. 5).

The documents show that Wärtsilä applies a structured and systematic approach to supplier monitoring and control. This includes formal audit rights, which allow them to

conduct inspections at suppliers' and even sub-supplier premises if required (Wärtsilä, 2021). In addition, "suppliers are responsible for the control and continuous improvement efforts of their sub-suppliers" (Wärtsilä, 2021, p. 1). Wärtsilä also has a "Supplier Compliance Assurance process" consisting of three phases: information collection, risk evaluation and "Vendor Management System rating" (Wärtsilä, 2021, p. 8). This indicates a structured multi-stage governance system. In addition, suppliers are subject to continuous performance evaluation based on key performance indicators (KPIs) (Wärtsilä, n.d.). The governance system also incorporates a continuous audit cycle, including re-audits and corrective actions where necessary (Wärtsilä, n.d.).

Supplier reporting emerges as an important governance mechanism for Wärtsilä. According to the Supplier Requirements, suppliers are required to provide information on their environmental impacts, including emissions and energy consumption (Wärtsilä, 2021). In addition, Wärtsilä has initiated a "baseline assessment of greenhouse gas emissions for selected suppliers", which provides a foundation for monitoring progress over time (Wärtsilä, 2026, p. 38). This suggests that supplier data collection is connected to both formal reporting requirements and continuous improvement initiatives. Wärtsilä also states in their Supplier Requirements, that their suppliers "shall not subcontract any major part of the supply, without written consent from Wärtsilä" (2021, p. 1). This indicates direct control over parts of the supplier network.

In addition to control-based mechanisms, Wärtsilä incorporates collaborative governance practices to try to improve environmental supplier performance. These include supplier development processes, corrective action requirements, and capacity-building initiatives (Wärtsilä, n.d.; Wärtsilä, 2026). Suppliers are expected to participate in continuous improvement activities, and may face corrective actions if they fail to meet performance targets (Wärtsilä, n.d.) Furthermore, Wärtsilä engages with suppliers to support the adoption of emission reduction practices and works toward joint sustainability targets, such as a "25% reduction in supplier emissions by 2030" (Wärtsilä, 2026, p. 38). Wärtsilä also states in its annual report, that it will continue active engagement and

support with suppliers on effective carbon reduction methods (Wärtsilä, 2026, p. 38). These practices show ongoing communication and cooperation with suppliers, but the documents provide limited concrete examples of these collaborative initiatives.

5.2.2 Influencing factors

Wärtsilä's approach to supplier environmental governance is shaped by a combination of internal capabilities, external pressures, and supply chain factors. Internal governance is supported by clearly defined organisational structures, and the responsibility for sustainability is distributed across different levels of the organisation. The Board of Directors oversees the implementation of the sustainability strategy and monitors progress against targets, while the Audit Committee is responsible for sustainability-related reporting, internal controls, and risk management (Wärtsilä, 2026, pp. 90-91). In addition, the Board of Management is responsible for overall sustainability performance, including the approval of policies, targets, and action plans (Wärtsilä, 2026, p. 90). These structures indicate that sustainability governance is embedded within Wärtsilä's organisational decision-making and supported by formal accountability mechanisms.

Wärtsilä operates in a regulatory environment characterised by increasing sustainability requirements, including the Corporate Sustainability Reporting Directive (CSRD), which creates a need for structured reporting and transparency (Wärtsilä, 2026). The company also aligns its practices with international frameworks such as the UN Global Compact, which is mentioned in their Supplier Handbook (Wärtsilä, n.d., p. 7). Wärtsilä's Code of Conduct states that the company complies with laws in every country where they do business and that similar principles apply to all suppliers (Wärtsilä, 2025). The Code of Conduct also refers to continuous research and development, as well as measurable emission reduction targets covering the supply chain (Wärtsilä, 2025).

The complexity of Wärtsilä's supply chain further influences governance practices. Wärtsilä operates within a global, multi-tier supply network, where a significant share of

environmental impacts, particularly greenhouse gas emissions (GHG), originates from value chain activities, such as raw material extraction and processing (Wärtsilä, 2026, p. 99). This limits the extent to which the company can directly control environmental performance in the supply chain.

5.2.3 Implementation challenges

The findings highlight several challenges associated with supplier environmental governance at Wärtsilä. One key challenge relates to the indirect control in the supply chain. Wärtsilä requires suppliers to ensure that sub-suppliers comply with its requirements, but this creates a reliance on suppliers to extend governance further in the supply chain (Wärtsilä, 2021). As a result, the effectiveness of governance depends not only on Wärtsilä's own mechanisms, but also on the capabilities and practices of its suppliers.

Data-related challenges also emerge as a significant limitation. Although Wärtsilä has established systems for collecting and analysing environmental data, the availability and quality of data depend on suppliers' ability to provide accurate and comprehensive information. The company's efforts to improve data accuracy, particularly in relation to Scope 3 emissions, are constrained by the development of supplier reporting capabilities (Wärtsilä, 2026). This introduces uncertainty into environmental assessments and limits the ability to monitor supplier performance.

5.3 Metso

5.3.1 Governance mechanisms

Metso's environmental supply chain governance is structured around formal compliance requirements, monitoring and assessment, reporting mechanisms, and supplier development practices. The Supplier Code of Conduct establishes environmental expectations for suppliers (Metso, 2024). Metso requires suppliers to "be committed to protect the

environment in accordance with applicable laws and regulations” (Metso, 2024, p. 2), and to “continually look for ways to minimise waste and emissions from their operations, products and services” (Metso, 2024, p. 2). Additionally, suppliers are “encouraged” to manage their own carbon footprint in their operations and suppliers, and if requested, to “develop a CO2 emission reduction plan” (Metso, 2024, p. 2). These supplier requirements suggest a combination of mandatory compliance and encouraged continuous improvement as the basis of supplier environmental governance.

Monitoring and control mechanisms emerge from the corporate documents as a central part of Metso’s governance approach. Metso monitors and screens relevant suppliers through watch and sanctions lists, media, and regular audits (Metso, 2024). Suppliers are required to grant access for Metso or a separate third party to “relevant premises and information to conduct on-site audits” (Metso, 2024, p. 5). These governance practices are supported by a broader due diligence process discussed in Metso’s annual Sustainability Statement, where Metso states that its “approach to its supply chain is based on a systematic and risk-based due diligence process” (Metso, 2026a, p. 74). This is further supported by “screening and assessment methods... covering the full value chain” (Metso, 2026a, p. 75) and audits conducted both as “desktop assessment or on-site physical inspections” (Metso, 2026a, p. 75). These findings suggest that Metso differentiates the intensity of governance based on risk and relevance, instead of applying identical practices across all suppliers. Additionally, supplier performance is monitored through “reporting systems, using key performance indicators” (Metso, 2026a, p. 125). This is supported by audits, including “172 internal and 13 third-party supplier audits” (Metso, 2026a, p. 126).

Supplier reporting appears as another key governance mechanism. Metso “may require regular reports, including CO2 data” (Metso, 2024, p. 2), as well as broader reporting on the supplier’s overall environmental impacts. (Metso, 2024, p. 5). This is supported by practices discussed in the Sustainability Statement’s “Key global actions in 2025” section, which include “collecting in-depth production related CO2 emissions quantitative and

qualitative data from suppliers”, and improvements in “supplier-related categorisation and ESG data-collection” (Metso, 2026a, p. 126).

Enforcement mechanisms are clearly stated in the public documents of Metso. Suppliers are required to “remedy any non-conformity identified without delay” (Metso, 2024, p. 5), and failure to comply can have negative consequences, as Metso “may suspend or terminate the contract” (Metso, 2024, p. 5) if the supplier does not adhere to the Supplier Code of Conduct. Metso also states that it does not engage in business with a potential supplier if they don’t comply with its Code of Conduct principles (Metso, n.d., p. 7).

Metso’s governance approach extends further into the supply chain. Suppliers are required to “evaluate and monitor” their own supply chain and confirm that their own suppliers comply with the Supplier Code of Conduct (Metso, 2024, p. 6). Additionally, “Metso expects the Supplier’s full co-operation should Metso wish to conduct on-site audits at the Supplier’s sub-suppliers” (Metso, 2024, p. 6), extending the governance beyond the direct contractual relationship.

Metso also incorporates collaborative approaches alongside assessment and control-based mechanisms. The company states that it “regularly connects with its supplier base to support, advise and educate them on sustainability”, aiming for better performance (Metso, 2026a, p. 76). Suppliers are encouraged to set their own climate targets and commit to initiatives such as the Science Based Targets initiative (SBTi) (Metso, 2026a, p. 125). In addition, suppliers are supported in developing “CO2 emission reduction plan and setting their own CO2 reduction targets” (Metso, 2026a, p. 125). The findings suggest that Metso’s governance includes some collaborative and capability-building efforts.

5.3.2 Influencing factors

Much like the other case companies, the supplier environmental governance of Metso is affected by both internal capabilities and external regulatory and stakeholder pressures. Sustainability is defined as a “strategic priority” (Metso, 2026a, p. 59). Governance responsibilities are embedded at the highest organisational level, as the Board of Directors “oversees Metso’s sustainability governance and sustainability agenda execution”, and approves sustainability targets and policies (Metso, 2026a, p. 70). Additionally, Metso’s cross-business Sustainability Steering Committee coordinates implementation across the organisation, and governance of procurement is overseen by the Procurement Leadership Teams (Metso, 2026a). This shows that, based on the documents, the supplier governance is supported by formal organisational arrangements and connected to strategic decision-making.

Metso identifies that stakeholder expectations and legislation are driving the sustainable energy transition (Metso, 2026a, p. 60). Metso aligns its sustainability targets with external frameworks such as the SBTi to reduce its carbon footprint in its own operations and supply chain (Metso, 2026a, p. 60). In 2025, its sustainability agenda was updated with double materiality analysis to understand “stakeholder expectations, covering impacts, risks and opportunities across the entire supply chain” (Metso, 2026a, p. 62). These findings show that external expectations shape governance priorities, but they are translated into internal systems and processes rather than directly determining governance practices.

The complexity of Metso’s supply chain also affects the governance approach. Metso operates with “around 17,000 suppliers... in 82 countries” (Metso, 2026a, p. 68) and “a significant portion of Metso’s manufacturing is outsourced” (Metso, 2026a, p. 66). This dispersed and multi-tier structure of the supply chain makes it necessary to use risk-based due diligence, selective monitoring and indirect governance mechanisms. Metso’s approach to governance reflects a strong orientation towards value chain sustainability.

They emphasise due diligence processes, alignment with the Supplier Code of Conduct, and continuous engagement with suppliers (Metso, 2026a).

5.3.3 Implementation challenges

The findings also reveal challenges and limitations with Metso's supplier environmental governance. One major challenge relates to the availability and quality of the data. Metso acknowledges in its Sustainability statement that "a number of metrics... are based on the estimates, averages and assumptions" and that there is a "risk of error in the data, particularly in the completeness of data where several sources have been combined or manually processed" (Metso, 2026a, p. 63). Scope 3 emissions are largely calculated from secondary data, with reliance on estimates in some areas (Metso, 2026a, pp. 95–96). These limitations create uncertainty in the environmental assessments and limit the accuracy of supplier evaluation.

While Metso states that its suppliers have to ensure compliance with their own suppliers, there is a concern about the indirect nature of control in the wider supply chain. The effectiveness of governance is at least partly dependent on the capabilities and commitment of suppliers, which suggests a potential implementation gap between formal requirements and practical implementation. External dependencies also limit the effectiveness of governance. Metso notes that its ability to reduce emissions is dependent on "policymakers and energy market development in individual countries" where it operates (Metso, 2026a, p. 90).

The findings suggest limitations in the scope of environmental governance. Metso states that it does not yet "explicitly address circularity or include provisions for sourcing raw materials based on circular economy principles or the use of renewable resources" (Metso, 2026a, p. 106). This suggests that governance is currently focused more on emissions, compliance and due diligence, while circularity and the use of renewable resources receive less attention in supplier governance.

6 Cross-case analysis

This section compares the findings across KONE, Wärtsilä and Metso. The analysis follows the same structure as the case findings. First, governance mechanisms are compared, then influencing factors, and finally, implementation challenges. The purpose is to identify broader patterns in how the three Finnish industrial MNCs govern supplier environmental sustainability, what factors shape these practices and what challenges appear across the cases.

6.1 Governance mechanisms across cases

Across all three cases, supplier environmental governance is based on a combination of formal requirements, monitoring systems, reporting obligations, enforcement mechanisms, and supplier engagement practices. The main difference is in how these mechanisms are used. KONE's governance is more clearly focused on selected key and high-impact suppliers, Wärtsilä's approach is closely connected to operational supplier control, and Metso relies strongly on risk-based due diligence and supplier engagement around climate targets (see Table 2).

Table 2. Comparison of governance mechanisms from the studied cases

Governance mechanism	KONE	Wärtsilä	Metso	Cross-case interpretation
Formal requirements	Supplier Code of Conduct, and Environmental Annex -> more detailed requirements for key suppliers	Supplier Requirements, Supplier Handbook, and Code of Conduct	Supplier Code of Conduct, Code of Conduct and procurement related due diligence requirements	All companies use formal rules as the foundation. However, the level of specificity and public transparency varies
Monitoring and audits	Supplier screenings, audits, annual assessments, supplier scorecards	Compliance assurance process, inspections, audits, re-audits, KPI monitoring	Risk-based due diligence, screening, self-assessments, internal and third-party audits	Monitoring is established in all cases, but Metso and Wärtsilä appear more explicitly process oriented, and KONE's approach is more targeted
Reporting and data collection	Supplier sustainability scorecards, emissions data, EPD/CBAM related data	Environmental impact data, emissions and energy consumption, GHG baseline for selected suppliers	CO2 reporting, ESG data collection, suppliers' emissions data, KPI reporting	Reporting evidence is strong in all cases, but data requirements vary in many cases and apply only to selected suppliers
Supplier selection and enforcement	Purchasing decisions informed by scorecards, requirements stronger for key suppliers	Supplier approval and subcontracting restrictions, corrective actions	Acceptance criteria, contract suspension/termination, and supplier exclusion	Enforcement mechanisms exist in all three cases, but Metso and Wärtsilä appear to show clearer formal exclusion/control mechanisms
Multi-tier governance	Risk-based supplier evaluation due to limited visibility beyond direct suppliers	Suppliers responsible for sub-suppliers, audit rights extend to sub-suppliers	Suppliers must monitor own supply chain -> "Metso may audit sub-suppliers"	All case companies try to extend governance further into supplier networks, but implementation remains mostly indirect
Collaboration and supplier development	Training, joint development, emissions targets, low-carbon materials and circularity initiatives	Corrective actions, supplier development, support for emissions reduction	Supplier education, SBTi engagement, and CO2 reduction plans	Collaboration complements control mechanisms, but evidence of concrete outcomes varies

The comparison in Table 2 shows that none of the case companies rely on a single governance mechanism. Instead, they combine assessment mechanisms, such as codes of conduct, audits and reporting requirements, with collaborative practices such as supplier support, training and target-setting. The main difference comes from which mechanisms are emphasised by each company. In broad terms, KONE focuses more on high-impact and key suppliers, Wärtsilä emphasises structured operational control and continuous audits, while Metso relies on risk-based due diligence.

6.1.1 Formal requirements

While all three companies use clear formal requirements as the foundation for supplier governance, the level of specificity and public transparency differs between cases. Wärtsilä appears to provide the most operationally specific requirements in public supplier documents, including environmental compliance requirements, restrictions for hazardous materials and obligations extending to sub-suppliers (Wärtsilä, 2021, pp. 1-2, 6). KONE also uses formal supplier requirements, as all suppliers are required to sign the Supplier Code of Conduct, and key suppliers sign the Environmental Annex, which lists more detailed environmental requirements (KONE, 2026b, p. 18). However, the Environmental Annex does not appear to be publicly available online, which limits the external visibility into the exact requirements. In comparison to Wärtsilä and KONE, Metso's Supplier Code of Conduct is more based on principles and includes softer wording like "the Supplier is encouraged" to manage their carbon emissions and "Metso may require regular reports" (Metso, 2024, p. 2). Metso's Sustainability Statement shows that these requirements are operationalised through procurement policy, supplier acceptance criteria, audits and due diligence (Metso, 2026a). Overall, the findings suggest that supplier codes of conduct provide only a partial view of environmental governance, as more detailed practices can be found in sustainability statements, supplier handbooks, and other procurement documents.

6.1.2 Monitoring and audits

Monitoring and auditing are among the most developed governance mechanisms in these cases. The approach to monitoring, however, differs between the companies. KONE's monitoring is strongly targeted to strategically important and high-impact suppliers, as reflected in its annual Supplier Sustainability Assessment, Supplier Sustainability Scorecards and engagement with the 200 largest material suppliers, accounting for approximately 75% of total purchase spend (KONE, 2026b, p. 18). Wärtsilä's monitoring appears more operationally embedded, as its Supplier Compliance Assurance process includes information collection, risk evaluation, and Vendor Management System rating, which is supported by inspections, audits, re-audits and KPI-based performance evaluation (Wärtsilä, n.d., pp. 8–15; Wärtsilä, 2021, p. 1). Metso's monitoring is specifically connected to risk-based due diligence, including screening and assessment methods covering the full value chain, as well as internal and third party audits. (Metso, 2026a). This indicates that monitoring is a central mechanism in all case companies, but the operational logic differs between them.

6.1.3 Reporting and data collection

Reporting and data collection are also important governance mechanisms in all three cases. KONE uses supplier data in Supplier Sustainability Scorecards and purchasing decisions. The assessed data includes suppliers' emission reporting aligned with the GHG Protocol, Environmental Product Declaration data, CBAM reporting and regulatory compliance (KONE, 2026b, p. 18). Wärtsilä requires suppliers to provide information on environmental impacts, including emissions and energy consumption (Wärtsilä, 2021, p. 8), and in 2025, Wärtsilä finalised a baseline assessment of GHG emissions for selected suppliers (Wärtsilä, 2026, p. 38). Metso uses CO₂ reporting, supplier ESG data collection and KPI based reporting systems, including detailed supplier emission data collection (Metso, 2026a, pp. 125–126). These findings show that reporting is not only used for

transparency, but also for evaluating and comparing suppliers. At the same time, the dependence on data provided by the suppliers links governance mechanisms directly to implementation challenges, because monitoring depends on the availability, quality and comparability of supplier data.

6.1.4 Supplier selection and enforcement

Supplier selection and enforcement mechanisms connect governance to purchasing decisions, supplier approval and potential exclusion. KONE ties supplier sustainability performance to purchasing decisions and reserves the right to terminate contracts in cases of serious compliance violations (KONE, 2025a, p. 5). Wärtsilä shows formal control through supplier approval thresholds (Wärtsilä, n.d., p. 8), subcontracting restrictions (Wärtsilä, 2021, p. 1), and requirements for corrective actions (Wärtsilä, n.d., pp. 11, 15). Metso requires suppliers to meet financial, sustainability, and quality acceptance criteria (Metso, 2026a, p. 105), and non-compliance can lead to contract termination or suspension (Metso, 2024, p. 5). Overall, these mechanisms show how supplier governance is connected to supplier selection, closer monitoring and possible exclusion. However, this also reinforces the selective nature of supplier environmental governance, as stricter control may be concentrated on suppliers considered high-risk, strategically more important, or more relevant to emissions and purchasing impact.

6.1.5 Multi-tier governance

Multi-tier governance appears across the cases, but it also shows the indirect nature of supplier environmental governance. For example, KONE maps material supply chains from direct suppliers to material manufacturers, particularly in relation to material-related emissions (KONE, 2026b, p. 18), but the findings also point to limited visibility beyond direct suppliers (KONE, 2026a, pp. 50, 64). Wärtsilä and Metso make governance beyond the first-tier suppliers more explicit by combining delegated responsibility with

audit rights. Wärtsilä requires suppliers to control and improve the performance of their sub-suppliers (Wärtsilä, 2021, p. 1), while Metso states that suppliers must monitor their own supply chains and allow audits at sub-suppliers if needed (Metso, 2024, p. 6). The findings suggest that all three companies attempt to extend environmental governance beyond first-tier suppliers, but the practical implementation is partly dependent on suppliers' own ability and willingness to govern their networks.

6.1.6 Collaboration and supplier development

Collaboration and supplier development also appear in all three cases, but they mainly function as complementary methods to assessment and control-based mechanisms. KONE gives the clearest examples of collaborative governance through supplier training, one-to-one dialogue and joint development activities, and support for emissions reduction. For example, KONE collaborates with suppliers in setting emission reduction targets and developing corrective action plans (KONE, 2026a, pp. 50, 59) and explores low-carbon materials and circular practices (KONE, 2026b, pp. 18–20). Wärtsilä also includes collaborative elements, especially through supplier development processes (Wärtsilä, n.d., p. 17), corrective actions (Wärtsilä, n.d., pp. 11, 15) and engagement with suppliers to adopt carbon reduction methods (Wärtsilä, 2026, p. 38). Metso's collaborative mechanisms are mainly linked to supplier education and climate targets, as the company supports suppliers in sustainability issues (Metso, 2026a, p. 76), encourages them to commit to SBTi (Metso, 2026a, p. 125) and engages them on regulatory topics such as CBAM (Carbon Border Adjustment Mechanism) and EUDR (EU Deforestation Regulation) (Metso, 2026a, p. 126).

Overall, the public documents provide more evidence of collaborative intentions and engagement processes than of concrete outcomes from these different initiatives. While supplier training, target-setting, and dialogue are mentioned across the cases, the reports provide little detail on how suppliers' capabilities have actually changed. It is also unclear how widely collaboration extends beyond key suppliers or what measurable

environmental improvements have resulted from these activities. This makes collaborative governance difficult to assess from public documents alone.

6.2 Influencing factors across cases

The cross-case findings show that supplier environmental governance is shaped by several different connected factors. These include internal organisational capabilities, supply chain structure, external regulatory and stakeholder pressures, and dependence on supplier data and capabilities. Internal structures affect how well formal requirements are translated into operational practices. On the other hand, the complexity of the supply chain influences how closely companies can monitor and influence suppliers. External pressures increase the need for measurable and auditable governance, especially in relation to emissions reporting and climate targets. However, the practical effectiveness of these mechanisms depends on supplier capabilities, available reliable data, and the extent to which changes can be made outside the lead company's direct control.

6.2.1 Internal organisational capabilities

Internal organisational capabilities appear to be a central factor in explaining the implementation of supplier environmental governance mechanisms across the cases. KONE's implementation is supported by dedicated teams, while the sustainability targets are embedded in the annual performance goals and key purchasing roles (KONE, 2026b, p. 18). This helps explain how KONE operationalises governance through scorecards, assessments, purchasing decisions and targeted supplier engagement. Wärtsilä's internal capabilities are more closely connected to formal risk and management structures. Wärtsilä also has top governing bodies involved in monitoring sustainability progress and approving sustainability policies, targets and action plans (Wärtsilä, 2026, pp. 90-91). Similarly, Metso embeds governance into formal organisational structures, as its Board oversees sustainability governance (Metso, 2026a, pp. 70-71), and the specified Procurement

Leadership Team oversees procurement governance (Metso, 2026a, p. 105). Across the analysed cases, internal capabilities are not only background conditions. They are part of how formal expectations are translated into practical governance.

6.2.2 Supply chain structure and complexity

The structure and complexity of the supply chain also help to explain the implementation and effectiveness of supplier environmental governance mechanisms. Across the cases, environmental impacts are strongly connected to upstream supply chains, purchased goods, materials and logistics. This limits the direct control and increases reliance on supplier-level action. For KONE, supplier governance is shaped by the concentration of material-related emissions, as high impact suppliers are responsible for about 80% of material-related emissions, and KONE engages closely with its 200 largest material suppliers (KONE, 2026b, p. 18). Wärtsilä's governance is influenced by the need to manage operational supplier processes and sub-supplier responsibilities, as suppliers are responsible for the control and continuous improvement of their sub-suppliers (Wärtsilä, 2021, p. 1). Metso's governance is shaped by the scale and dispersion of its supplier base, as it has around 17,000 suppliers in 82 countries (Metso, 2026a, p. 68), and a significant portion of manufacturing is outsourced (Metso, 2026a, p. 66). These findings suggest that supply chain complexity not only creates a need for supplier governance, but also constrains its effectiveness by making complete visibility and direct control of lower-tier suppliers difficult. This helps explain why the case companies do not apply governance evenly across the full supplier base, but instead concentrate on selected suppliers, high-risk areas, material-related emissions, or suppliers with greater strategic relevance.

6.2.3 Regulatory and stakeholder pressures

Regulatory and stakeholder pressures also help explain why supplier environmental governance becomes more data-driven and target-oriented in the three cases. KONE's

supplier assessments include emissions reporting aligned with the GHG Protocol, Environmental Product Declaration data, CBAM reporting and regulatory compliance (KONE, 2026b, p. 18). This shows that external reporting and regulatory demands are translated into supplier-level data expectations. Wärtsilä is also influenced by regulatory and stakeholder expectations, as its documents refer to CSRD alignment, UN Global Compact, and rapidly evolving environmental regulation (Wärtsilä, 2026, p. 67). Metso's approach reflects similar pressures through legislation, stakeholder expectations, SBTi targets, and supplier engagement on CBAM and EUDR (Metso, 2026a, pp. 125-126). Beyond broader commitments, these pressures are visible in reporting requirements, emissions data, supplier targets and compliance mechanisms. This suggests that external pressure strengthens supplier governance when it becomes measurable through data, targets and follow-up mechanisms.

6.2.4 Supplier data and capability dependence

Finally, the findings indicate that supplier data quality and capabilities affect how governance mechanisms work in practice. Although all case companies have established reporting and monitoring systems, they rely on suppliers and service providers for accurate, comparable, and timely information. This is visible in KONE's use of manual processes, estimates and secondary data when primary data is unavailable (KONE, 2026a, p. 64). Wärtsilä is also dependent on the development of service providers' capabilities for increasing the amount of primary data in logistics (Wärtsilä, 2026, p. 126), while Metso uses estimates, assumptions and secondary data in Scope 3 emissions calculations (Metso, 2026a, p. 63). These findings link directly to potential effectiveness, as monitoring and assessment depend on supplier data quality and on the capabilities behind the data.

Overall, the cases show that similar governance mechanisms are applied differently depending on the company's internal systems, structure of the supply chain, reporting

requirements, and supplier capabilities. This helps to explain why supplier governance remains selective, partly indirect and dependent on data quality.

6.3 Implementation challenges

The cross-case findings show that the main implementation challenges are not caused by a lack of governance mechanisms. All three case companies report several formal and collaborative governance mechanisms. The challenge is rather how far these mechanisms reach, how consistently they are applied, and how well they lead to measurable outcomes. Three challenges are especially visible in these cases. There are limitations with data quality and supplier reporting, selective and indirect governance, and the gap between environmental targets and practical outcomes. These themes were not only based on the coding framework, but also appeared repeatedly in the analysed documents, especially in relation to data quality, dependence on suppliers and the role of external actors.

6.3.1 Data quality and reporting limitations

Data quality and supplier reporting limitations are the clearest and most consistent implementation challenges from the analysis. Even though all three case companies have established reporting and monitoring systems, these systems depend on the availability, comparability, and accuracy of supplier environmental data. KONE reports limitations related to data collection, estimates, and emission factors, and uses secondary data when primary data is not available (KONE, 2026a, p. 64; KONE, 2026b, p. 19). Wärtsilä also aims to improve Scope 3 data accuracy by increasing the amount of primary data, but notes that this also depends on further development of the service providers' capabilities (Wärtsilä, 2026, p. 126). Metso also identifies risks related to estimates, assumptions and completeness of data, as their purchased goods and services Scope 3 emissions are calculated using secondary data (Metso, 2026a, pp. 63, 95).

These findings show that supplier governance depends on both formal governance mechanisms and the quality of information behind them. Without quality data from suppliers, even well-established audit and reporting systems remain partly uncertain as governance tools. This also connects with prior research, which suggests that lead companies can struggle to verify supplier practices beyond their direct organisational space (Busse et al., 2017; Villena & Gioia, 2020).

6.3.2 Selective and indirect governance

The findings show that supplier environmental governance is not applied evenly across the full supplier bases of the case companies. Each case company uses a different logic for prioritising suppliers. KONE's supplier selection is driven by purchase relevance and emissions impact, as it engages closely with the "200 largest material suppliers" and focuses its Annual Sustainability Assessment on targeted suppliers (KONE, 2026b, p. 18). As mentioned, these targeted supplier accounts for about 75% of the purchase spend, and their "key suppliers" account for "about 80% of material-related emissions". This shows that KONE concentrates governance on suppliers that are most relevant to emissions and purchasing impact. At the same time, engagement and visibility for other suppliers remain less clear. Wärtsilä's selectivity appears to be less focused on a specific group of suppliers and more embedded in operational control.

The Supplier Requirements of Wärtsilä extend audit rights to sub-suppliers and make suppliers responsible for the control and improvement of their own sub-suppliers (Wärtsilä, 2021, p. 1). This shows a formal effort to extend governance past first-tier suppliers. However, it also creates indirect dependence, as the daily governance of lower-tier suppliers is partly delegated to direct suppliers, even though Wärtsilä can set requirements and hold audit rights. Wärtsilä's case shows how formal control can stretch to lower tiers of suppliers while also depending on suppliers' own capabilities to implement governance. Metso's coverage is more clearly risk-based, as its supply chain approach is

described as “systematic and risk-based due diligence”, especially in high-risk countries (Metso, 2026a, pp. 74-77). This means that Metso prioritises governance based on supplier risk and geography, making the supplier base more manageable. However, the governance intensity still depends on risk classification.

The focus of the logic of selection and governance intensity can vary. The challenge is not simply that governance mechanisms are missing. Rather, large multi tier supplier networks make full coverage difficult, as it is also a structural trait of global supply chains. Lead companies can request information, conduct audits, and set requirements, but monitoring all suppliers and sub-suppliers equally would require enormous resources. This leads to delegation and prioritisation of governance, which can limit consistent environmental implementation for the full supply chain. This is in line with previous research showing that lead companies face difficulties in monitoring suppliers operating in different institutional contexts (Busse et al., 2017; Mol & Lee, 2024; Villena & Gioia, 2020).

6.3.3 Implementation gap between targets and outcomes

A third implementation challenge concerns the gap between the environmental governance targets and the practical outcomes. In all three cases, the companies set requirements for suppliers, establish climate-related targets and engage suppliers to reduce emissions. Even so, achieving these targets depends partly on different actors and conditions outside of the lead company’s direct control. Supplier environmental governance can guide, support and monitor suppliers, but it cannot completely determine environmental outcomes in global supply chains.

The gap appears differently in each case. For KONE, it is especially visible in relation to material emissions and industry readiness. KONE works with its key suppliers on reducing emissions, but does not mandate SBTi participation because many steelmakers face technological and industry constraints. Related industries are also decarbonising at a

pace that affects KONE's ability to reduce emissions (KONE, 2026a, p. 64; KONE, 2026b, p. 19). In Wärtsilä's case, the gap is more closely linked to supplier capabilities and adoption, as the company's target of a 25% reduction of supplier emissions by the year 2030 depends on suppliers adopting effective carbon reduction methods (Wärtsilä, 2026, p. 38). Metso also faces industry constraints, as it states that emission reduction partly depends on energy market development and policymakers (Metso, 2026a, p. 90). In addition, Metso also states that circularity is not yet explicitly addressed in its procurement policy (Metso, 2026a, p. 105).

Overall, the cases show that implementation gaps arise from practical constraints in supplier networks and industries. The findings point out the difficulty in turning supplier governance into measurable outcomes, as many of the environmental impacts caused are rooted in wider value chains. This is in line with earlier literature on supply chain governance, suggesting that formal governance mechanisms like standards, audits and codes of conduct may be insufficient to guarantee material improvements in supplier practices. Suppliers may face capability limitations, cost pressures, different institutional conditions and information asymmetries, which can limit the effectiveness of sustainability requirements set by the lead company (Koberg & Longoni, 2019; Soundararajan et al., 2019; Villena & Gioia, 2020).

7 Conclusions

This chapter presents the conclusions of this study. First, the key findings are discussed by answering the research questions. Then, theoretical contributions and practical implications of the study are presented. Finally, the limitations of the study and suggestions for future research are discussed. The purpose of the thesis was to examine how Finnish multinational corporations govern environmental sustainability within their global supplier networks, what factors affect the implementation and potential effectiveness of these governance mechanisms, and what challenges they face. The findings show that the case companies have established broad supplier governance systems, but the main challenges come from their reach and ability to produce measurable environmental improvements. These challenges are linked to lower-tier visibility, supplier data quality and dependence on supplier capabilities.

7.1 Key Findings

The key findings are presented by answering the three research questions of the study.

RQ1: How do Finnish multinational corporations govern environmental sustainability within their global supplier networks?

The findings show that KONE, Wärtsilä and Metso use both assessment-based and collaborative governance mechanisms to govern supplier environmental sustainability. In all three cases, governance is built on formal supplier requirements, such as supplier codes of conduct, environmental requirements, audits, monitoring, and reporting obligations. These mechanisms form the basic structure that companies use to set expectations and evaluate supplier performance. The companies also report using collaborative practices, including supplier training, online and in-person meetings, target-setting, supplier development, and support for emissions reduction. These findings broadly support existing literature, which describes supplier environmental governance as a combination of formal control and more relational forms of governance, where assessment is often

complemented by collaboration (Formentini & Taticchi, 2016; Koberg & Longoni, 2019; Bonatto et al., 2022).

A more critical finding is that the documents provide clearer evidence of formal control mechanisms than of the outcomes of collaborative mechanisms. Training, dialogue, support and supplier engagement are mentioned in all cases, but the reports provide less detail on whether these activities have improved supplier capabilities or produced measurable improvements. This does not necessarily mean that there is no collaboration, but it shows that collaborative governance is more difficult to assess through public documents alone. This also supports concerns in earlier literature that sustainability governance can be easier to present in formal documents than to prove actual outcomes (Soundararajan et al., 2019; Hettler & Graf-Vlachy, 2024).

The findings also show that governance is not applied equally to all suppliers. The selectivity of governance appears understandable, as these companies, like most large MNCs, operate within a large multi-tier supply chain where it would be difficult to apply the same level of governance to all suppliers. Stronger governance is therefore directed towards strategically important, environmentally relevant, and high-risk suppliers, while the rest of the supplier base is monitored in more general detail. This supports earlier research, which has shown that lead companies can struggle to reach beyond the first-tier of suppliers and consistently manage sustainability in global supplier networks (Busse et al., 2017; Villena & Gioia, 2020; Mol & Lee, 2024). In this study, the selective governance can be understood as a practical response to the complexity of global supply chains.

RQ2: What factors explain the implementation and effectiveness of environmental governance mechanisms in global supply chains?

The findings suggest that the implementation and potential effectiveness of supplier environmental governance cannot be explained by a single factor. Instead, they are shaped by external pressures, internal organisational capabilities, supply chain structure and

supplier capabilities. Regulatory and stakeholder pressures help explain why companies move towards more formalised supplier governance. In all three cases, emissions reporting, supplier data, climate targets, and EU regulatory requirements were visible in the corporate documents. This is in line with earlier literature showing that regulators, investors, customers and other stakeholders put pressure on companies to take responsibility for sustainability in the value chain (Marculetiu et al., 2023; Vidal et al., 2023).

However, external pressure alone does not explain how governance is implemented. The case companies also rely on internal structures such as sustainability and procurement teams, board-level oversight, supplier assessment systems, and data processes. This supports the Resource-Based View (RBV), as internal capabilities help explain how sustainability strategies are translated into practical governance (Barney, 1991; Hart, 1995; Longoni & Cagliano, 2018). In this sense, stakeholder theory helps to explain the external pressures behind governance, and RBV helps explain the internal capabilities needed to implement it.

The findings also show that supply chain structure affects governance, as a large part of the environmental impact is outside the companies' direct control, which creates a dependence on the supplier's ability to provide data, set targets, and implement environmental improvements. This supports earlier research arguing that global supply chains are affected by the visibility gap, institutional differences and variation in supplier capabilities (Busse et al., 2017; Villena & Gioia, 2020). Overall, the findings support the theoretical framework of the thesis, but they also show that the factors are closely connected in practice instead of being separate from each other.

RQ3: What challenges do multinational corporations face when implementing environmental governance practices in global supply chains?

The most relevant challenge for the case companies was data quality. All case companies have established reporting and monitoring systems, but they depend on the availability and reliability of supplier environmental data. The findings show reliance on estimates,

secondary data and assumptions, as well as dependence on the suppliers' and service providers' capabilities. Therefore, data quality affects the credibility of supplier governance as a whole. This supports earlier literature on the difficulty of collecting and verifying reliable supplier and Scope 3 data (Busse et al., 2017; Hettler & Graf-Vlachy, 2024).

A second challenge is that governance remains selective and indirect at times. The analysed Finnish MNCs extend their governance beyond direct suppliers through delegated responsibility, audit rights, risk- and relevance-based prioritisation and focused collaboration. However, complete visibility and equal monitoring of all suppliers and sub-suppliers is difficult in large global supply chains. Therefore, selectivity seems to be understandable, but it also raises the question of how companies define their focus areas and what remains outside of closer monitoring. This aligns with earlier research showing that lead companies can depend on indirect influence, as they often struggle with reaching lower tiers of suppliers (Busse et al., 2017; Villena & Gioia, 2020).

A third challenge is the implementation gap between targets and outcomes. The analysed case companies set environmental requirements and targets for suppliers, but the implementation depends to some extent on actors and conditions outside the lead company's control. These can include industrial conditions, like in the case of the decarbonisation pace in KONE's material industries, and Metso, depending on wider market and policy developments in the energy sector. This supports earlier literature, which argues that standards, codes and audits don't necessarily lead to substantial improvements in supplier practices (Koberg & Longoni, 2019; Soundararajan et al., 2019).

Overall, the findings suggest that supplier environmental governance should not be evaluated only by the existence of policies, targets or formal mechanisms. A multinational company may have a developed governance structure and still face limitations in data quality, lower-tier visibility, supplier capabilities and control over practical outcomes. The main issue is therefore not only governance adoption, but whether these mechanisms

can produce reliable information, reach relevant suppliers and support measurable environmental improvements.

7.2 Theoretical contributions

This study contributes to existing literature on supplier environmental governance and sustainable supply chain management (SSCM) in three main ways. First, the study supports previous research that has identified formal requirements, monitoring, audits and supplier collaboration as central mechanisms in supply chain governance (Formentini & Taticchi, 2016; Koberg & Longoni, 2019; Bonatto et al., 2022). The findings show how the analysed Finnish MNCs do not rely on one governance approach, but combine assessment and collaborative mechanisms. This supports earlier literature suggesting that formal control mechanisms are often needed to set expectations and monitor suppliers, while collaborative practices are needed to support supplier development and capacity building.

Second, the study supports the use of stakeholder theory and the resource-based view (RBV) together in analysing supplier environmental governance. The findings show that stakeholder and regulatory pressures help explain why companies adopt supplier governance mechanisms, and internal capabilities help explain how these mechanisms are organised and implemented. This is in line with stakeholder theory, which emphasises the role of external expectations in shaping company behaviour (Freeman, 1984), and with RBV, which explains the role of internal resources and capabilities in implementing sustainability practices (Barney, 1991; Hart, 1995; Longoni & Cagliano, 2018). Therefore, the study provides empirical insight into how pressure and internal capabilities both matter in the reported implementation of supplier governance.

Third, the study contributes by highlighting the importance of implementation challenges in supplier environmental governance. The findings show that data quality, selective governance and indirect control can limit the potential effectiveness of governance

mechanisms. This supports earlier research showing that lead companies can face difficulties when monitoring lower tier suppliers and verifying practices in large global supply chains (Busse et al., 2017; Villena & Gioia, 2020). The findings are also aligned with research by Soundararajan et al. (2019) and Hettler and Graf-Vlachy (2024), suggesting that formal mechanisms, such as standards, audits and codes of conduct, do not automatically lead to measurable improvements in supplier practices. Companies may have formal governance mechanisms in place, but public documents do not always show if these mechanisms lead to real environmental improvements.

7.3 Practical implications

In addition to theoretical contributions, the study provides practical implications for multinational corporations. Companies should manage data quality as a core governance capability, not only as a reporting requirement for suppliers. Identifying risks, setting targets, making purchasing decisions, and assessing suppliers all require reliable data. Thus, investments in primary data, supplier guidance, digital tools and verification processes are important for effective governance. Companies should also be more transparent about how they exercise selective governance. While risk-based and targeted governance approaches are understandable in large supply chains and supplier networks, companies should clarify why they concentrate on certain suppliers, how other groups of suppliers are governed, and how governance is extended to lower tiers of suppliers. Otherwise, some environmental risks can stay outside the more developed governance mechanisms.

Collaborative supplier development should be connected more clearly to the actual outcomes. Supplier training, meetings, and engagement programmes are all useful, but they should be connected to evidence of actual improvements on supplier capabilities, data quality, emissions or other environmental outcomes. This is important, because collaboration is generally presented as a way to address the limits of assessment-based governance, but its effects are difficult to evaluate from public documents.

Finally, the findings indicate that lead companies cannot solve sustainability issues in supply chains alone. Supplier environmental governance is a broader challenge requiring better standards and regulations, data infrastructure, and industry solutions, as different industry actors, policymakers, and technology providers shape the conditions for environmental improvements.

7.4 Limitations and future research suggestions

This study has a few limitations that should be acknowledged. The empirical material is based on public corporate documents, which are useful for analysing how MNCs describe and structure their governance. However, these documents cannot fully verify whether all reported practices are actually implemented in the same way in practice, or whether they lead to measurable improvements with suppliers. This is particularly relevant for collaborative governance, as companies can often describe the mechanisms much more clearly than the actual outcomes.

The study focuses on three Finnish industrial multinational corporations. The multiple-case study design allows for relevant comparison, but the findings cannot be generalised to all multinational corporations or other sectors. The industrial context can shape the results, as emissions related to materials, outsourced manufacturing, and complex supplier networks are especially important for industries in which the case companies operate. The study also reflects mainly the lead companies' perspective, as it does not include interviews among suppliers, managers, or other external stakeholders, nor independent environmental data. As a result, the analysis does not fully present how suppliers experience governance mechanisms or how they respond to buyer requirements.

Future research could address the limitations of this study. A more detailed understanding could be developed by interviewing sustainability and procurement managers of multinational corporations, and suppliers could provide practical insights on how environmental governance works beyond formal documents. Supplier interviews would be

particularly useful, as they could show how different governance mechanisms are experienced in practice from their perspective. Research could also examine how CSRD, CSDDD, and other related regulations affect the environmental governance of suppliers, and if the regulations lead over time to more substantive governance, or if they only generate more extensive reporting. Finally, future research could combine qualitative analysis with broader environmental performance data in order to examine whether specific governance mechanisms are more connected to measurable outcomes, such as lower emissions from suppliers.

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Appendices

Appendix 1. Coding framework

Category	Code	Sub-Code	Description	Example indicator
Assessment-based mechanisms	A1	Supplier Code of Conduct	Formal requirements for suppliers	Environmental standards, compliance rules
Assessment-based mechanisms	A2	Audits and monitoring	Formal evaluation of supplier compliance	Audits, third-party assessments and monitoring systems
Assessment-based mechanisms	A3	Reporting requirements	Requirement for suppliers to report environmental data	Emission reporting, ESG data collection, Scope 3 data requests
Assessment-based mechanisms	A4	Supplier selection and exclusion	Environmental performance criteria in supplier selection and disqualification	ESG-based supplier screening and criteria in selection and qualification
Collaborative mechanisms	A5	Supplier training	Activities for improving supplier capabilities	Training programmes, workshops and guidance for suppliers
Collaborative mechanisms	A6	Capability building	Long-term joint development of supplier capabilities	Joint initiatives, programmes, and co-investments
Collaborative mechanisms	A7	Information sharing	Exchange of knowledge and best practices	Knowledge sharing, joint learning and two-way information flow
Influencing factors	B1	Regulatory pressure (CSRD)	Influence of EU and other reporting standards and obligations	References to EU, and other, standards and scope 3 reporting obligations
Influencing factors	B2	Internal capabilities	Internal resources, systems and structures	Internal processes, systems, and dedicated teams
Influencing factors	B3	Supply chain complexity	Structural characteristics (multi-tier structure and global reach)	Multi-tier suppliers, structural complexity
Implementation challenges	C1	Lack of visibility	Limited insights into lower-tier suppliers	References to lower-tier visibility gaps
Implementation challenges	C2	Data limitations	Inaccessibility and incomplete environmental data	Missing data, unreliable supplier metrics, inconsistent reporting
Implementation challenges	C3	Implementation gap	Discrepancy between stated governance policies and actual practices	Difficulty of enforcing standards, gaps in policy and practice

Appendix 2. Use of artificial intelligence

Artificial intelligence (AI), specifically the AI tool ChatGPT by OpenAI, was used to support the writing process of this thesis. AI was used in accordance with academic integrity and transparency following the university's guidelines. AI was utilised to support preliminary source identification, language refinement, and to improve the text's overall structure and clarity. AI was not used as a scientific source or as a substitute for academic literature. All suggestions and content generated by AI were critically evaluated and confirmed by the author. The author is fully responsible for the accuracy, originality, and academic integrity of the thesis.