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The impact of ESG reporting on supply chain risk management and resilience

School of Technology and Innovations
Master's Thesis in Industrial Management
Master's Programme in Industrial Management

Vaasa 2026

UNIVERSITY OF VAASA
School of Technology and Innovations
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Title of the thesis: The impact of ESG reporting on supply chain risk management and resilience
Degree: Master of Science in Economics and Business Administration
Degree Programme: Industrial Management
Supervisor: Ines Simoes de Brito Peixoto
Year: 2026 **Pages:** 77

ABSTRACT:

Sustainability and corporate responsibility reporting has become significantly more widespread over the past decade. Stakeholders, as well as regulations and directives, require consistent ESG reporting, and it is no longer based on voluntary participation. Companies has growing need to manage risks related to supply chains in a changing and uncertain operating environment. The importance of ESG perspectives has been emphasized as part of strategic management and risk management. The aim of this study is to examine how ESG reporting is used to support supply chain risk management and how it leverages supply chain resilience. The theoretical framework of the study is based on the concepts of strategic management, supply chain risk management, and ESG reporting, and resilience. The study was conducted as a qualitative multi-case study focusing on four Finnish global companies: Neste, UPM, Wärtsilä, and KONE. The data used consists of the companies' annual reports, sustainability reports, and other public sustainability-related publications from their own sites from 2023–2025.

The results show that ESG reporting is no longer merely a tool for external communication but is increasingly integrated into companies' risk management and strategic decision-making. ESG helps companies identify risks related to the supply chain, such as environmental risks, resource availability, labor conditions, and supplier compliance. In practice, risks are managed through measures such as supplier audits, traceability systems, risk-based assessments, and continuous monitoring. The study also shows a clear link between ESG reporting and supply chain risk management and resilience. ESG methods improve supply chain transparency and visibility across the entire supply chain, enabling risks to be identified early enough to prepare for them and allowing for a more effective recovery to supply chain disruptions. Consequently, it may be possible to prevent disruptions from escalating by addressing them at an early stage. Furthermore, practices such as supplier diversification, scenario analysis, and long-term sustainability planning support preparedness and adaption for various situations and the ability to adapt after problems arise.

ESG reporting functions as a practical tool for managing supply chain risks and strengthening resilience. Companies that integrate ESG methods into their procurement, supplier management, and strategic planning are better positioned to handle disruptions and maintain a long-term performance.

KEYWORDS: sustainability reporting, sustainable development, sustainable development goals, risk management, resilience, supply chains, suppliers, strategic leadership

VAASAN YLIOPISTO
Tekniikan ja innovaatiojohtamisen akateeminen yksikkö
Tekijä: Julia Björklund
Tutkielman nimi: The impact of ESG reporting on supply chain risk management and resilience
Tutkinto: Kauppatieteiden maisteri
Oppiaine: Tuotantotalous
Työn ohjaaja: Ines Simoes de Brito Peixoto
Valmistumisvuosi: 2026 **Pages:** 77

Tiivistelmä:
Kestävä kehitys ja vastuullisuus raportointi on yleistynyt viimeisen vuosikymmenen aikana huomattavasti. Nykyään sidosryhmät sekä asetukset ja direktiivit vaativat johdonmukaista ESG raportointia, eikä se enää perustu vapaaehtoisuuteen. Tämän tutkimuksen lähtökohtana on yritysten kasvava tarve hallita toimitusketjuihin liittyviä riskejä muuttuvassa ja epävarmassa toimintaympäristössä. Erityisesti ESG näkökulmien merkitys on korostunut osana strategista johtamista ja riskien hallintaa. Tutkimuksen tavoitteena on tarkastella, miten ESG-raportointia hyödynnetään toimitusketjun riskienhallinnan apuna sekä millainen vaikutus sillä on toimitusketjun resilienssiin. Tutkimuksen teoreettinen viitekehys perustuu strategisen johtamisen, toimitusketjujen riskienhallinnan sekä ESG-raportoinnin ja resilienssin käsitteisiin. Tutkimus toteutettiin laadullisena monitapaustutkimuksena, jossa käsiteltiin neljää suomalaista kansainvälistä yritystä: Neste, UPM, Wärtsilä ja KONE. Aineistona on käytetty yritysten vuosikertomuksia, vastuullisuusraportteja sekä muita julkisia vastuullisuuteen liittyviä julkaisuja yritysten omilta sivuilta vuosilta 2023–2025.

Tulokset osoittavat, että ESG-raportointi ei ole enää pelkkä ulkoisen viestinnän väline, vaan se on yhä enemmän integroitu osaksi yritysten riskienhallintaa ja strategista päätöksentekoa. ESG:n avulla yritykset tunnistavat toimitusketjuun liittyviä riskejä, kuten ympäristöön liittyvät riskit, resurssien saatavuus, työolot sekä toimittajaverkostoihin liittyviä haasteita. Riskejä hallitaan käytännössä esimerkiksi toimittaja auditointien, jäljitettävyysjärjestelmien, riskiperusteisten arviointien ja jatkuvan seurannan avulla. Tutkimus osoittaa myös selkeän yhteyden ESG-raportoinnin ja toimitusketjun riskien hallinnan sekä sen resilienssin välillä. ESG-menetelmillä saadaan parannettua toimitusketjun läpinäkyvyyttä ja näkyvyyttä koko toimitusketjun välisissä tapahtumissa, mikä mahdollistaa riskien tunnistaminen tarpeeksi aikaisin ja niihin varautumisen sekä mahdollistaa tehokkaamman palautumisen. Näin ollen pystytään mahdollisesti välttämään ongelmien suureneminen, kun siihen puututaan aikaisessa vaiheessa. Lisäksi esimerkiksi toimittajien hajaannuttaminen, skenaariotyöskentely ja pidemmän aikavälin vastuullisuussuunnittelu tukevat valmistautumista erilaisiin tilanteisiin ja sopeutumiskykyä ongelmien jälkeen.

ESG-raportointi toimii käytännön työkaluna toimitusketjun riskienhallinnassa ja resilienssin vahvistamisessa. Yritykset, jotka integroivat ESG-menetelmiä hankintaan, toimittajahallintaan ja strategiseen suunnitteluun pystyvät paremmin selviytymään häiriötilanteista ja ylläpitämään suorituskykyään pitkällä aikavälillä.

AVAINSANAT: kestävyysraportointi, kestävä kehitys, kestävän kehityksen tavoitteet, riskienhallinta, resilienssi, toimitusketjut, tavarantoimittajat, strateginen johtaminen

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Abbreviations

CSRD	**Corporate Sustainability Reporting Directive**
CSR	**Corporate Social Responsibility**
ESG	**Environmental Social Governance**
ESRS	**European Sustainability Reporting Standards**
GRI	**Global Reporting Initiative**
SASB	**Sustainability Accounting Standards Board**
SC	**Supply Chain**
SCR	**Supply Chain Resilience**
SCRM	**Supply Chain Risk Management**
TCFC	**Task Force on Climate-related Financial Disclosures**

1 Introduction

Environmental, social, and governance (ESG) issues have become increasingly relevant in corporate decision-making, particularly as companies face growing expectations from regulators, investors, and society to operate more responsibly (Zhang, 2023, pp. 792-793). At the same time, global supply chains have become more complex and interconnected, which has increased their exposure to different types of disruptions and risks (Dolgui & Ivanov, 2021, pp. 3-4). These developments have led to a growing interest in how sustainability related practices and risk management are linked in supply chain context. While ESG reporting frameworks such as GRI, SASB, and TCFD are widely used to improve transparency and standardise sustainability disclosures, their role in supporting supply chain risk management and resilience is still not clearly defined (Du Toit, 2024, pp. 2-4; Molnar, 2025, pp. 2-3).

This thesis examines how ESG reporting is used as a tool for identifying, disclosing, and managing supply chain risks, and how these practices relate to supply chain resilience. The study combines theoretical perspective on supply chain risk management, ESG integration, and resilience with an empirical analysis of selected Finnish industrial companies, Wärtsilä, Neste, UPM, and KONE. These companies operate in global supply networks and are publishing comprehensive sustainability reports, which makes them relevant companies for examining how ESG reporting is applied in practice. The aim of the study is to better understand how ESG frameworks are integrated into supply chain risk management processes and how they can support more effective and resilient supply chain operations.

1.1 Research background and research gap

In recent years ESG considerations have gained increasing importance in corporate management and decision-making due to growing societal expectations, regulatory pressure, and sustainability challenges (Zhang, 2023, pp. 792-793). Supply chains have become more complex and globally interconnected, which has increased their exposure to

disruptions and sustainability related risks. While research on sustainable supply chains is already well established, the role of ESG reporting within this context is still developing. Earlier studies indicate that only a small share of large companies reported sustainability related information in the 1990s, whereas by 2020 most large corporations disclosed ESG related data as part of their reporting practices (KPMG, 2020). The expansion of sustainability reporting has been strongly influenced by regulatory developments and increasing stakeholder expectations. Within the European Union, reporting requirements have gradually become more comprehensive, and recent initiatives such as the Corporate Sustainability Reporting Directive (CSRD) aim to further standardise ESG disclosures and improve their quality (Ahmad et al., 2025, pp. 2-3).

While sustainable supply chain research is mature, the specific role of ESG frameworks in supply chain risk and resilience remains fragmented. Recent SLRs call for integration across tiers and clearer governance/metrics (Truant et al., 2024). While prior studies have examined ESG performance and supply chain sustainability, fewer studies have explored the roles of ESG reporting as a mechanism that enhance transparency, supports risk identification, and enables better coordination across supply chain networks. This thesis addresses this gap by examining how ESG reporting is used in practice to manage supply chain risks and supports resilience in large industrial companies.

1.2 Research Questions and objectives

The purpose of the study is to examine how ESG reporting is used in the context of supply chain risk management and resilience. In particular, the study focuses on how companies apply ESG reporting frameworks to identify, disclose, and manage supply chain risks, and how these practices support more resilient supply chain operations. Next four research questions are guiding this thesis.

Q1 = What types of supply chain risks are mostly addressed in ESG reporting?

Q2 = How do companies disclose and manage these risks in their ESG and sustainability reports?

Q3 = What is the relationship between ESG reporting and supply chain resilience?

Q4 = How can companies integrate ESG reporting more effectively into strategic supply chain risk management?

This study is aiming to provide a comprehensive understanding about the role of ESG reporting beyond transparency, by analysing how it contributes to risk identification, co-ordination, and decision making within supply chains. ESG reporting practices will be explored in case companies, and by that the study seeks to clarify how ESG frameworks are integrated into SCRM and to identify ways in which ESG reporting can be used more effectively as part of strategic SCM. In addition, the study aims to contribute to existing literature by linking ESG reporting practices with supply chain resilience, which remains an underexplored area.

1.3 Scope, Limitations and Structure of the study

This study focuses on large Finnish industrial companies that operate in global markets, have complex supply chains, and provide relatively extensive ESG and sustainability disclosures. This makes them suitable case companies for examining how ESG reporting is applied in practice in relation to SCRM. This study is limited to publicly available reports, which means that the analysis is based on disclosed information rather than internal company data. As a result, the findings reflect how companies present and communicate their ESG practices.

The thesis is structured for five chapters. Chapter 1 is introduction chapter, where the topic, purpose and background of the study is introduced. Chapter 2 is presenting the theoretical background, including supply chain risk management, ESG integration, reporting frameworks, and supply chain resilience and challenges. Chapter 3 describes the

research methodology, which including using case companies' annual reports and sustainability reports as a source. Chapter 4 presents the empirical findings from the case companies. Chapter 5 discusses the results and provides conclusion.

2 Theoretical background

This chapter presents the key theoretical concepts relevant to this study, focusing on supply chain risk management, ESG and ESG integration, and supply chain resilience, and relationships of all of them. It is exploring ESG principles and SCRM as a structured process for identifying and managing risks increasingly complex and interconnected supply networks. Furthermore, it explores how ESG considerations are integrated into strategic management and how ESG frameworks and standards support organizations in measuring, managing, and reporting sustainability related issues. The chapter introduces the concept pf supply chain resilience, emphasizing the ability of organizations to prepare for, respond to, and recover from disruptions. The role of ESG within supply chains is also discussed, highlighting how sustainability related risks and practices extend across supply network actors. The relationship between ESG and supply chain resilience is also examining, providing a foundation for understanding how ESG reporting may contribute to improved risk management and resilience outcomes.

2.1 ESG

ESG refers to a framework used to evaluate how organizations manage sustainability related impacts and responsibilities in their operations and business relationships (Khamisu et al., 2024, pp. 2-3). ESG expands traditional financial performance assessments by incorporating environmental stewardship, social responsibility, and governance transparency as factors influencing long-term organizational value and risk exposure (Zhang, 2023, pp 792-793). As sustainability challenges such as climate change, social inequality, and governance failures have become increasingly important, ESG has emerged as a central concept in corporate sustainability and responsible business practices.

The ESG framework consist of three main dimensions. The environmental dimension addresses issues such as greenhouse gas emissions, resource efficiency, and environmental impacts of production activities (Khamisu et al., 3-4). The social dimension focuses on labor practices, employee wellbeing, human rights, and relationships with communities

and stakeholders (Khamisu et al., 2024, p. 4). The governance dimension includes organizational structures and processes that ensure transparency, accountability, and ethical decision making, including board oversight, corporate policies, and anti-corruption practices (Khamisu et al., 2024, p. 4).

The concept of ESG has developed from earlier ideas of corporate social responsibility (CSR) and corporate sustainability, which emphasized the role of business in addressing social and environmental challenges (Montiel, 2008, pp. 245-247). However, ESG offers a more structured and systematic approach of evaluating sustainability performance and risk by integrating environmental, social, and governance indicators into corporate assessment frameworks, thereby enabling organizations and stakeholders to better capture non-financial factors that influence long-term value creation and risk exposure (Zhang, 2023, pp. 792-793). As a result, ESG has become increasingly integrated into corporate governance, reporting practices, and strategic decision making.

2.1.1 Strategic management and ESG integration

Strategic management involves aligning organizational resources and capabilities with changing external conditions to support long-term performance and competitiveness, particularly in complex environments such as global supply chains (Truant et al., 2024). Strategic management increasingly include ESG considerations as part of organizational planning and risk management, like sustainability indicators such as carbon emissions, resource efficiency, labor practices, and governance transparency including them into business decisions, that lead to better ability to identify risks and opportunities that influence long-term performance and competitiveness (Barbosa et al., 2023, pp 2-5).

Recent research highlights that ESG integration can strengthen organizational capabilities and support sustainable innovation when sustainability considerations are embedded within corporate operations and management practices. For example, Sun et al. (2024) demonstrates that ESG- oriented strategies can impact positively on green innovation and sustainable organizational performance when environmental and social

objectives are incorporate into strategic planning. Similarly, Thun et al. (2024) show that integrating sustainability initiatives into core corporate strategy can improve the reliability of corporate sustainability efforts and influence how stakeholders and financial analyst evaluate company performance.

In addition to strategic benefits, ESG integration can improve corporate transparency and governance practices. Organizations that integrate sustainability considerations into their governance systems are in a better position to monitor environmental and social impacts and manage emerging risk more effectively and communicate these outcomes to stakeholders more effectively (Barbosa et al., 2023, pp. 2). As ESG issues increasingly influence regulatory requirements, stakeholder expectations, and market dynamics, integrating sustainability considerations into strategic management has become an important element of long-term competitiveness. Importantly, ESG integration is closely connected to supply chain management. Numerous environmental and social risks occur within supply chain including issues related to resource use, labor conditions, and regulatory compliance. As a result, companies are increasingly integrating ESG criteria into their management systems and decision-making processes to monitor and control the impact of their business practices throughout their supply chain on both internal and external environments. (Barbosa et al., 2023, pp 2).

This extension of ESG governance to supply chain also contributes to the development of supply chain resilience. Supply chain resilience refers to ability to supply chain to anticipate, respond to, and recover from disruptions and operational risks. Research suggest that ESG-related governance mechanism, transparency, and monitoring practices can improve coordination and risk identification within supply chains, thereby supporting stronger resilience capabilities (Shekarabi et al., 2025, pp. 681-683).

Overall, integrating ESG considerations into strategic management enables organizations to strengthen risk management, improve transparency, and support sustainable performance across their operations and supply chains. These developments highlight the

importance of ESG integration as a strategic mechanism that links corporate governance, sustainability reporting and supply chain resilience.

2.2 Integrating ESG frameworks and standards

As ESG practices have expanded within sustainability and governance, a variety of reporting frameworks and standards have been developed to guide organizations in disclosing sustainability related information (Du Toit, 2024, pp. 2-3). These frameworks aim to improve the transparency, comparability, and credibility of corporate sustainability disclosures across industries and countries (Du Toit, 2024, p. 4). Academic research indicates the standardized ESG reporting frameworks help organizations communicate sustainability performance while also supporting stakeholders' ability to evaluate environmental and social impacts (Molnar, 2025, pp. 2-3).

One of the most widely adopted sustainability reporting framework is the Global Reporting Initiative (GRI). The GRI standards provide detailed guidelines that allow organizations to report their economic, environmental, and social impacts in a structured and consistent manner (Graessler et al., 2024, p. 4). These standards are based on principles such as materiality, stakeholder inclusiveness, and sustainability context, which guide organizations in identifying the most relevant sustainability issues affecting their operations (Grasseler et al., 2024, pp. 5-6). Research suggests that the widespread adoption of the GRI framework has significantly improved the comparability and transparency of sustainability reporting across organizations (Du Toit, 2024, pp. 5-6).

Another important ESG reporting framework is the Sustainability Accounting Standards Board (SASB), which focus on industry specific sustainability issues that may influence financial performance. Unlike broader sustainability frameworks, SASB standards emphasize financially material ESG issues that are particularly relevant for investors and financial analysts (Matuszak et al., 2025, pp. 3-5). By identifying sector specific ESG risks and performance indicators, SASB aims to improve the decision usefulness of sustainability disclosures for capital markets (Molnar, 2025, pp.3-4).

In addition to voluntary reporting standards, sustainability reporting has increasingly been shaped by regulatory developments in many regions (Ahmad et al., 2025, pp. 2-3). Whitin European Union, the European Sustainability Reporting Standards (ESRS) have been introducing under the Corporate Sustainability Reporting Directive (CSRD) to strengthen sustainability disclosures (Ahmad et al., 2025, p. 3). These standards require organizations to provide detailed information about environmental impacts, governance structures, and sustainability risks across their operations and value chains (Ahmad et al., 2025, pp. 4-5). A key feature of the ESRS framework is the concept of double materiality, which requires companies to assess both the financial impact of sustainability issues and the impact of corporate activities on society and the environment (Molnar, 2025, p. 5).

Climate related disclosure frameworks have also gained increasing importance within ESG reporting practices. The Task Force on Climate-related Financial Disclosures (TCFD) provides recommendations for reporting climate related governance, strategy, risk management, and performance metrics (Lukacs et al., 2025, pp. 4-6). According to Lukacs et al. (2025) these disclosures aim to help organizations and investors better understand how climate related risk and opportunities may affect long-term business performance and operational stability.

Although different ESG frameworks focus on different aspects of sustainability reporting, research has shown that they often complement each other rather than compete directly (Molnar, 2025, pp. 6-7). Organizations frequently adopt multiple reporting frameworks to address the information needs of different stakeholders and regulatory requirements (Du Toit, 2024, pp 6-7). For instance, companies may use the GRI framework to report broader sustainability impacts while simultaneously using SASB or ESRS standards to disclose financially material ESG risks (Matuszak et al., 2025, pp. 6-7).

ESG reporting frameworks provide structured guidance for organizations seeking to improve transparency and accountability in sustainability reporting (Du Toit, 2024, pp. 7-8). By establishing standardized indicators and reporting principles, these frameworks support more systematic identification and management of sustainability risks (Molnar, 2025, pp. 7-8). This is particularly important for supply chains, where environmental and social risks often originate and where transparency can support more effective risk monitoring and governance (Ahmad et al., 2025, pp.6-7). Consequently, integrating ESG reporting frameworks into corporate governance systems can help organizations improve sustainability risk management and support the development of more resilient supply chains (Lukacs et al., 2025, pp. 6-7).

2.2.1 TCFD framework

The TCFD is one of the most influential frameworks within ESG reporting, particularly in relation to climate related risks and opportunities (Lukacs et al., 2025, pp. 4-5). The framework provides structured recommendations for organisations to disclose information across four key areas: governance, strategy, risk management, and metrics and targets (TCFD, 2017; Lukacs et al., 2025, pp. 4-5). These components are intended to improve transparency regarding how organisations identify and manage climate related risks within their operations and decision-making processes (TCFD, 2017).

The relevance of the TCFD framework for this study lies in its strong connection to risk management, as it explicitly integrates climate related risks into organisational governance and strategic planning (TCFD, 2017). This includes both physical risks, such as extreme weather events, as well as transition risks related to regulatory changes, market developments, and technological shifts (Lukacs et al., 2025, pp. 5-6). These risks can be recognised as material factors that can influence long-term organisational performance and operational stability (Delmas et al., 2025, p. 5-6).

Speaking of supply chains, climate related risks often emerge across multiple tiers and affect suppliers, logistics networks, and production processes (Lukacs et al., 2025, pp. 5-

6). The TCFD framework encourages organizations to assess these risks within their own operations and above that also across their value chains, in that way supporting more comprehensive risk identification and improved visibility of supply chain vulnerabilities (TCFD, 2017; Lukacs et al., 2025, pp. 5-6). This is particularly important in complex and global supply networks where disruptions can propagate across interconnected actors and affect overall supply chain performance (Delmas et al., 2025, pp. 6-7).

TCFD framework promotes the use of scenario analysis to evaluate how different climate related developments may impact business operations over time (TCFD, 2017). This approach looks forward and enables organizations to anticipate potential disruptions and develop proactive strategies to mitigate their impacts. By integrating scenario analysis into decision making processes, organizations can strengthen preparedness and improve ability to respond to uncertainty within supply chains (Lukacs et al., 2025, pp. 5-6).

Recent research further suggests that climate related disclosure frameworks such as TCFD improve the credibility and relevance of sustainability information by linking disclosures more closely with financial risk assessment and strategic planning processes (Delmas et al., 2025, pp. 5-6). This integration improves the ability of organizations and stakeholders in understanding how climate risks influence long-term performance, governance practices, and operational resilience (Delmas et al., 2025, pp. 6-7). The framework emphasizes the importance of measurable indicators and targets, which improve the consistency and comparability of climate related disclosures across organizations (Lukacs et al., 2025, pp. 4-5). Increased transparency supports better decision making and facilitates better coordination between supply chain partners, particularly in managing environmental risks (Delmas et al., 2025, pp. 6-7).

As a conclusion, the TCFD framework plays important role in linking ESG reporting with supply chain risk management and resilience, as it embeds climate related risks into governance, strategy, and operational processes (TCFD, 2017). By improving transparency, strengthening systematic risk identification, and supporting forward looking decision

making, TCFD contributes to organizations' ability to prepare for, respond to, and recover from disruptions in supply chains (Lukacs et al., 2025, pp. 5-6).

2.3 Supply chain risk management

Supply chain risk management (SCRM) is widely recognized as a systematic and continuous process through which organisations identify assess, mitigate, monitor, and respond to risks that can possibly disrupt supply chain operations and performance (Das & Perona, 2025, pp. 3-4). The growing complexity and globalization of supply networks have increased the exposure of organisations to operational disruptions, which highlights the importance of systematic risk management within supply chains (Christopher & Peck, 2004, pp. 2-3). As supply chains involve multiple interconnected parts such as suppliers, manufacturers, logistics and distributors, if there are disruptions occurring at one step of the network it may affect the performance of the whole supply system (Tang, 2006, pp. 451-452).

Supply chain risks are commonly categorised into several groups, including supply risks, demand risks, operational risks, and external disruption risks (Tang, 2006, pp. 452-453). These categories help organisations systematically identify potential sources of vulnerability and focus risk management efforts across supply chain activities (Das & Perona, 2025, pp. 4-5). The supply chain risk management process is typically conceptualised as consisting of several interconnected stages to start with risk identification (Das & Perona, 2025, pp. 5-6). During this stage, organisations attempt to detect vulnerabilities within supply chain structures, supplier relationships, and operational processes (Das & Perona, 2025, p. 6). Risk identification methods usually include supply network mapping, supplier evaluation, disruption scenario analysis, and analysis of historical disruption events (Tang, 200*6,* pp. 453-454).

The second stage involves risk assessment, where identified risks are analysed according to their probability of occurrence and their potential consequences for supply chain performance (Das & Perona, 2025, pp. 6-7). Through systematic risk assessment,

organisations can prioritise the most critical risks and allocate resources to mitigation strategies that reduce disruption impacts (Das & Perona, 2025, p. 7). This evaluation process enables firms to better understand how disruptions may influence operational efficiency, customer service levels, and overall supply chain performance (Tang, 2006, p. 454).

Following risk assessment, organisations implement risk mitigation strategies aimed at reducing either the probability of disruptions or their operational consequences (Shekarabi et al., 2025, pp. 682-683). Mitigation strategies include flexibility, redundancy, diversification, and collaboration among supply chain partners (Shekarabi et al., 2025, p. 683). Flexibility refers to the ability of supply chains to adjust sourcing, production, or logistics operations when disruptions occur (Tang, 2006, pp. 454-455). Redundancy involves maintaining safety stocks, alternative suppliers, or additional production capacity to ensure operational continuity during disruptions (Tang, 2006, p. 455). Diversification strategies reduce dependence on individual suppliers or geographic regions, while collaboration between supply chain partners improves information sharing and coordinate responses during disruption events (Christopher & Peck, 2004, pp. 7-8).

Another important component of SCRM is risk monitoring and control, which involves continuous observation of supply chain performance to detect early warning signals of disruption (Das & Perona, 2025*, pp. 8-9).* Advances in digital technologies have strengthened organisations' ability to monitor supply chains activities in real time (Spieske & Birkel, 2021, pp. 3-4). Technologies associated with Industry 4.0, including big data analytics, artificial intelligence, and digital monitoring systems, improve supply chain visibility and enable faster responses to emerging risk (Spiese & Birkel, 2021, pp. 5-6).

The structured nature of SCRM discussed is also illustrated in Figure 1, which present SCRM as a continuous and cyclical process. The figure 1 highlights how these stages are interconnected rather than sequential, forming an ongoing risk management cycle that supports continuous evaluation and improvement of supply chain performance. As

shown in the figure, these phases are not isolated but operate as an integrated system, reinforcing the idea that SCRM is a dynamic and iterative process rather than a one-time activity (Das & Perona, 2025, p. 7).

Figure 1 SCRM's five main phases. Adapted from DAS and Perona (2025, p. 7).

SCRM includes recovery and organisational learning processes, which focus on restoring supply chain operations after disruptions and strengthening preparedness for future events (Shekarabi et al., 2025, p. 684). Recovery strategies may involve redesigning logistics networks, reallocating resources, or adjusting supplier relationships to restore operational performance (Shekarabi et al., 2025, p. 684). Organisations can also use disruption experiences as learning opportunities to improve supply chain structures and strengthen future risk management capabilities (Christopher & Peck, 2004, pp. 8-9).

Consequently, SCRM is a key mechanism through which organisations develop resilient supply networks capable of adapting to uncertainty and maintaining operational continuity (Shekarabi et al., 2025, p. 682). Effective SCRM requires an integrated approach that combines structured risk management processes, technological capabilities, and collaboration among supply chain actors (Das & Perona, 2025, pp. 9-10). As supply network become increasingly complex and globally interconnected, organisations must adopt proactive risk management strategies that strengthen both operational stability and long-term resilience (Christopher & Peck, 2004, p. 8).

2.4 Supply Chain Resilience

Supply chain resilience has emerged as a central concept in supply chain management related research due to increasing exposure to disruptions caused by globalization, geopolitical instability, natural disaster, and pandemics (Pettit et al., 2010, p. 1). Early research defines supply chain resilience as the ability of supply chains to return to their original or improved state after experiencing disruptions, emphasizing recovery and continuity of operations (Christopher & Peck, 2004, pp 1-2). This perspective highlights the importance of designing supply chains that can absorb shocks and maintaining functionality under adverse conditions (Christopher & Peck, 2004, pp. 1-2).

Subsequent research has expanded this definition by emphasizing that resilience is not limited to recovery but also includes the ability to anticipate, prepare for, and adapt to disruptions over time (Pettit et al., 2010, p. 1). In this broader view, resilience is defined as the capacity of a system to survive, adapt, and grow in the face of turbulent change (Pettit et al., 2010, p. 1). Resilience can be seen as a balance between supply chain vulnerabilities and organizational capabilities (Pettit et al., 2010, p. 6). Vulnerabilities refers to factors that make a supply chain susceptible to disruptions, while capabilities represent the attributes that enable organizations to anticipate, respond to, and recover from such disruptions (Pettit et al., 2010, p6). The relationship between these two dimensions is critical, as resilience increases when capabilities are strengthened and vulnerabilities

are reduced (Pettit et al., 2010, p.6). This relationship is conceptualized as the “zone of resilience”, where organizations achieve optimal performance by aligning their capabilities with their level of risk exposure (Pettit et al., 2010, p. 7). If vulnerabilities exceed capabilities, supply chains become highly exposed to disruption, where excessive investment in capabilities may lead to inefficiencies and reduced profabilitity (Petit et al., 2010, p. 7). Therefore, achieving resilience requires a balance and strategic alignment between risk exposure and capability development (Pettit et al., 2010, p. 7).

In addition to internal capabilities, recent research emphasizes the importance of understanding disruption propagation within supply networks, often referred to as the “ripple effect” (Dolgui & Ivanov, 2021, p. 1). The ripple effect describes how disruptions circulate across interconnected supply chain bumps, enhancing the impact of local disturbances on the overall system (Dolgui & Ivanov, 2021, p. 2). Supply chains being highly associated, when disruptions affect a single bump it may spread across multiple tiers, influencing production, logistics, and inventory flows throughout the whole network (Dolgui & Ivanov, 2021, p. 2). This highlights the need of analyzing resilience at the network level rather than focusing exclusively on individual organizations (Dolgui & Ivanov, 2021, p. 1).

Recent literature further conceives resilience as a dynamic capability consisting of multiple interconnected dimensions, including preparedness, response, recovery, and adaption (Shekarabi et al., 2025, pp. 681-682). Preparedness refers to forecasting disruptions and developing preventive strategies, while response capabilities involve reacting effectively when disruptions occur (Shekarabi et al., 2025, pp. 682-683). Focus on recovery capabilities is on restoring operations after disruptions, where adaption involves learning from disruptions and improving future resilience (Shekarabi et al., 2025, pp. 682-683). This dynamic perspective emphasizes that resilience is not only seen as a static outcome but an ongoing process of learning and capability development (Shekarabi et al., 2025, pp 682-683). Research also identifies several key strategies for enhancing supply chain resilience, including flexibility, redundancy, diversification, and collaboration among supply chain partners (Christopher & Peck, 2004, pp. 5-6). Collaboration and information

sharing are particularly important, as they enable coordinated responses and improve visibility across supply chain networks (Christopher & Peck, 2004, pp. 5-6).

Furthermore, resilience is increasingly supported by digital technologies that enhance supply chain visibility, monitoring, and decision-making capabilities (Dolgui & Ivanov, 2021, p. 1). Technologies such as simulation models and data analytics enable organizations to better understand disruption scenarios and improve response strategies (Dolgui & Ivanov, 2021, p. 1). As a conclusion supply chain resilience is a multidimension and dynamic capability that emerges from the interaction between structural design, risk management practices and organizational learning (Pettit et al., p. 13). As supply chains continue to grow complexity and exposure to risks, resilience has become a critical capability for ensuring long-term operational stability and competitive advantage (Christopher & Peck, 2004, pp. 1-2).

2.5 Supply Chain resilience and relationship with ESG

Supply chain resilience and ESG performance are increasingly recognized as interdependent element of corporate sustainability. Supply chain resilience is commonly understood as the ability of a supply chain to prepare for, respond to, and recover from disruptions such as natural disasters, geopolitical instability, or pandemics (Christopher & Peck, 2004, pp. 2-3). These disruptions can affect not only operational and financial performance but also environmental and social outcomes, for example through increased emissions, supply shortages, or challenges in maintaining labour standards across global supply chain (Shekarabi et al., 2025, pp. 681-682). For this reason, resilience can be seen as an essential component of broader ESG strategies rather than only an operational capability.

As Pettit et al. (2013) argue, organisations that develop their capabilities such as visibility, collaboration, and flexibility are better able to respond to disruptions, and these same capabilities are closely linked to responsible and transparent supply chain practices. At the same time, strong ESG practices, including responsible sourcing and supplier

engagement, can enhance the ability of supply chains to adapt and maintain performance under disruptions (Shekarabi et al., 2025, pp. 682-683). Companies that actively manage supplier relationships, improve transparency, and ensure compliance with ethical standards are therefore more capable of maintaining both operational continuity and sustainability objectives during unexpected events.

Pettit et al. (2013) emphasise that resilience is built through capabilities that enable organisations to adapt, learn, and respond to continuously changing conditions, highlighting the dynamic nature of supply chains. From this perspective, both ESG practices and resilience capabilities contribute to strengthening ability to manage uncertainty and adapt to external pressures. In addition, Truant et al. (2024) suggest that integrating sustainability practices across supply chain tiers enhances coordination and responsiveness, further supporting the idea that ESG and resilience are connected withing supply chains. When ESG principles, such as ethical sourcing, social responsibility and governance transparency are embedded into these systems, they are enhancing adaptive capacity and learning potential (Porter and Kramer, 2011). Stakeholder theory further emphasizes that business have responsibilities, not only to shareholders but also employees, suppliers and communities affected by their operations. Maintaining a resilient, ethically managed supply chain in part of fulfilling a company's broader social contract and strengthens its legitimacy (Porter and Kramer, 2011).

Climate related risks further exemplify how ESG focused companies perform better during disruptions. Firms that have invested in sustainable practices, such as recourse efficiency, circular economy approaches, and transparent supplier relationship, tend to recover more effectively from environmental and regulatory changes. As Shekarabi et al. (2025) mote, proactive risk management and sustainability-oriented capabilities enhance ability to adapt and maintain performance under uncertainty. This demonstrates that ESG integration not only help recover more rapidly from external shocks but also strengthen long-term competitiveness through sustainable innovation and proactive risk management. In essence, effective ESG integration enhances preparedness and reduces

vulnerability, while resilience ensures that sustainability objectives remain achievable in uncertain environments (Christopher and Peck, 2004; Porter and Kramer, 2011).

2.5.1 ESG dimensions in supply chain resilience

From ESG perspective, supply chain resilience reinforces all three pillars, environmental, social, and governance. Environmentally, resilient supply chains reduce the need for emergency or expedited logistics during crises that often lead to higher emissions and promote resource efficiency through proactive planning (Christopher and Peck, 2004). From a social perspective, supply chain resilience supports the maintenance of fair labour practices and helps organisations avoid compromising human rights standards during disruptions. As Pettit et al. (2013) suggest, capabilities such as visibility, collaboration, and flexibility enable firms to maintain operational continuity while upholding responsible practices across their supply chain. In terms of governance, resilience reflects the presence of structured oversight, accountability, and risk management mechanisms that allow organisations face disruptions in a controlled and transparent manner.

Moreover, the link between ESG and resilience can be strengthened through structured risk assessment, supply chain mapping and the use of digital technologies. As Ivanov and Dolgui (2021) argue, digital supply chain tools improve visibility and enable organisations to model disruption scenarios, which supports more effective risk identification and response. Similarly, Spieske and Birkel (2021) highlight those technologies such as data analytics, artificial intelligence, and digital platforms enhance transparency, traceability, and coordination across supply chains. These capabilities allow detecting vulnerabilities earlier and respond to disruptions before escalating into larger systematic failures. Measuring this relationship requires the adoption of key performance indicators (KPIs) that capture both resilience and ESG effectiveness, for example the percentage of suppliers meeting sustainability standards or the frequency and duration disruption related delays (Christopher and Peck, 2004).

2.5.2 ESG, network capabilities and technological enablement

Recent evidence supports the view that ESG performance and supply chain resilience are deeply interlinked that collectively drive strategic sustainability. This aligns with the academic consensus that resilience and sustainability are not separate goals but complementary enablers of long-term value creation in global supply chains (Christopher and Peck, 2004; Porter and Kramer, 2011).

Previous work highlights that supply chain ESG management enhances supply chain resilience (SCR) not only directly but also through network capabilities that promote collaboration, information exchange, and conflict resolution across partners (Zhou et al., 2024, pp. 4–6, 13–14). Supply chain ESG management aligns ESG practices across upstream and downstream nodes, creating a coherent governance environment that supports quicker recovery under disruption. Zhou et al. (2024) further demonstrate that emerging technologies such as AI, machine learning, IoT, blockchain and digital twins, amplifies the effect of supply chain ESG management on network capabilities ($\beta = 0.033$, $p = 0.012$), by reducing information asymmetries and enabling real-time transparency. These findings align with existing resilience research emphasizing that visibility and collaboration accelerate disruption detection and response (Zhou et al., 2024).

2.5.3 ESG, capabilities and contextual factors

Conceptually, this mechanism is consistent with resource based and social capital perspectives: ESG-aligned partnerships create shared values and trust that lower coordination costs and enhance collective problem-solving abilities (Zhou et al., 2024 pp. 4–6). The fsQCA results reveals multiple viable configurations to resilience (pp. 18–19), implying firms can combine ESG governance, network capability, and digital technologies in diverse ways to achieve similar resilient performance (Zhou et al., 2024). ESG-oriented firms demonstrate superior capacity to prevent, absorb, and recover from disruptions. According to dynamic capability theory, ESG strengthens three dimensions of resilience, preventive, adaptive, and restorative capabilities (Yuan et al., 2025).

ESG engagement acts as a catalyst for developing what Yuan et al. (2025) describe as new quality productive forces, a combination of technological advancement, green innovation, and digital capability that supports long-term operational resilience. Digital transformation amplifies the positive relationship between ESG and resilience by enabling real-time monitoring, data transparency, and predictive risk analytics (Zheng and Huang, 2024). Firms leveraging technologies such as artificial intelligence, blockchain, and cardon-tracking systems are better equipped to anticipate disruptions and adjust operations accordingly.

Yuan et al. (2025) and Zheng and Huang (2024) both acknowledge that the institutional and organizational context can moderate the relationship between ESG and resilience. In environments where regulation supports sustainability practices, such as government incentives for green finance or ESG disclosure mandates, companies are often able to experience amplified benefits from ESG adoption. Similarly, firms with integrated sustainability governance structures, which is typical for many Finnish industrial sector companies, can better align corporate responsibility with resilience related objectives. As a conclusion, ESG management strengthens supply chain resilience by supporting preventive, adaptive, and restorative dimensions, while innovation, technology, and governance play an important role in enabling mechanisms that convert sustainability initiatives into long-term operational strength (Yuan et al., 2025; Zheng & Huang, 2024).

2.6 Challenges in ESG integration and SCRM

Despite the increasing adoption of ESG practices, integrating them into SCRM in practice remains challenging. Main difficulties relate to limited visibility across supply chains, where companies often lack reliable information beyond their direct supplier (Dolgui & Ivanov, 2021, pp. 3-4). Identifying environmental and social risks occurring upstream seems difficult, particularly in intricate global networks (Shekarian & Mellat Parast, 2021, pp. 308-309).

Another challenge is the practical integration of ESG considerations into existing organisational processes. In companies, it is common that sustainability, procurement, and risk management functions operate separately, which can slow down information sharing and weaken coordinated risk responses (Bansal & Roth, 2000, pp. 721-722). As a result, ESG issues may be reported without being fully embedded into operational decision-making processes (Ahmad et al., 2025). Limitations in data quality and reliability can reduce the effectiveness of ESG information, making it more difficult to use in operational risk management (Lukacs et al., 2025). According to Ahmad et al. (2025, pp. 5-6), ESG related information is often collected through supplier self-reporting, which may be incomplete or challenging to verify in practice. Lukacs et al. (2025, pp. 5-6) further emphasises that limitations in data reliability can weaken the effectiveness of monitoring systems and risk assessment processes.

Cost and resource limitations can also make implementation challenging. As Graessler et al. (2024, pp. 7-8) notes, activities such as supplier audits, traceability systems, and sustainability reporting require significant organisational effort and time, especially when managing large supplier bases. This can lead to differing implementation of ESG practices across supply chains. In addition, companies often face a trade-off between maintaining efficiency and building resilience.

Christopher and Peck (2004, pp. 10-11) argue that resilience-oriented strategies, such as diversification and redundancy, often increase operational costs, which can conflict with efficiency driven supply chain models. Supply chain risks are becoming more dynamic due to climate change, geopolitical instability, and regulatory developments. As Shekarabi et al. (2025, pp. 683-684) highlights, these risks evolve over time and require continuous adaption of both ESG practices and risk management approaches.

Based on the literature the ESG integration in supply chains is not only a technical issue but also an organisational and operational challenge, requiring improved data reliability,

better coordination, and stronger alignment between sustainability and risk management practices.

3 Methodology

This chapter outlines the research methodology used in this thesis, introducing the data used, and the overall research process. The purpose of this thesis is to examine the influence of ESG regulations on companies' supply chain functions. To achieve this, a multi-case study design is adopted to create a comprehensive understanding of how sustainability regulations will affect risk management practices and enhance the resilience of supply chain management. The multi-case study follows a qualitative research approach.

This research adopts a multi-case study design to gain a comprehensive understanding of the phenomenon discussed above. According to Yin (2009), a multi-case study involves the analysis of multiple cases to obtain a deeper view of the research subject, while allowing comparison and contracts between cases. This approach enables researchers to draw broader insights, identify patterns and formulate more generalizable and well-founded conclusions than would be possible through a single-case study (Yin, 2019).

3.1 Qualitative research

This study adopts qualitative research approach, as it focuses on understanding how ESG reporting is used in practice within supply chain risk management. Qualitative research is suitable for this study because it allows an in-depth analysis of complex organisational processes and practices based on textual data rather than numerical measurement.

The research is based on a multiple case study design, where four companies are analysed. The aim is not to generalise statistically, but to develop a deeper understanding of how ESG reporting is applied in different organisational context. The use of qualitative secondary data, such as sustainability reports and annual reports, enables the examination of real-world practices and supports the exploration of relationships between ESG reporting, supply chain risk management, and resilience.

3.2 Data collection

The data in this thesis is based on qualitative secondary data as it has been collected from both academic literature and annual reports, sustainability reports and other publicly available sustainability related disclosures from the case companies Wärtsilä, Neste, UPM and KONE. For Wärtsilä, the analysis is based on the Annual reports from 2024 and 2025 and Sustainability report 2024, complemented by additional material such as the Supplier Sustainability Development Programme and sustainability strategy disclosures available on the company's website. For Neste, the data includes the Sustainability Reports from 2023, 2024 and 2025, and the Annual report from 2025. For UPM, the study is based on the Annual Report from 2025, and the sustainability statement from 2024-2025, completed by additional disclosures from the Sustainability Data Hub and the Sustainability Supply Chain sections from UPM's website. For example, including sustainability governance and double materiality descriptions, and supplier related guidelines such as the Supplier and Third-Party Code of Conduct, and materials on human rights, supply chain programmes. and site level reporting. These sources provide detailed information on ESG governance, performance indicators, and supplier management practices. For, KONE, the analysis is based on the Sustainability reports from 2023 and 2024, and the Annual Report 2025, together with additional disclosures related to risk management and sustainability practices available on the company's website.

These documents provide information about the companies' strategies, governance structures, ESG initiatives and performance over the years. The objective of this research is analysing Finnish listed manufacturing companies in the contexts of the current state of their sustainability reporting. The empirical data part focused on mainly on the most recent reporting period (2023-2025), as these reports reflect current ESG practices and are aligned with recent regulatory developments such as the CSRD. Earlier reports from 2022 were reviewed when necessary to identify continuity in reporting practices.

The theoretical background of the study was constructed using peer-reviewed academic articles accesses through established scientific databases, including Scopus, Web of

Science, ScienceDirect, SpringerLink and Google Scholar. The selected literature focuses on supply chain risk management, ESG reporting, and supply chain resilience, with emphasis on recent studies published mostly between 2020 and 2025 to reflect current developments in the field.

The qualitative data from these diverse sources are analysed using content analysis, which allows for the identification of themes and patterns related to ESG reporting, supply chain risk management, and resilience. This approach is well-suited for examining textual data and exploring how companies describe and justify their sustainability performance and governance practices (Elo & Kyngäs, 2008).

3.3 Data selection

The case companies selected for this study: Wärtsilä, Neste, UPM, and KONE, represents large, internationally operating Finnish corporations within significant relevance to both the national economy and global markets. All four companies are publicly listed, which ensures a high level of transparency and availability of data through annual reports, sustainability reports, and ESG disclosures. This makes them suitable for this study, which is directly focusing on impact of ESG reporting on supply chain risk management and resilience.

These companies operate in industries with highly complex and globally distributed supply chains, including energy, manufacturing, forestry, and industrial services. Their operations rely on multiple supplier tiers, geographically dispersed production, and extensive logistics systems. This level of complexity increases their exposure to various supply chain risks, including environmental pressures, regulatory changes, operational disruptions, and geopolitical uncertainties. As a result, these companies provide a relevant and diverse context for examining how companies identify, manage, and disclose supply chain risks.

Furthermore, Wärtsilä, Neste, UPM, and KONE are all actively engaged in sustainability and ESG practices. Each of these companies publishes comprehensive sustainability reports aligned with international frameworks, which enables a detailed examination of how ESG considerations are integrated into supply chain management and risk mitigation practices. Their strong focus on sustainability also makes them particularly relevant for exploring the connection between ESG reporting and supply chain resilience.

By selecting companies from different industries, this study is able capture variation in supply chain structures, risk exposures, and ESG approaches. This enhances the robustness of the analysis and allows for more comprehensive understanding of how ESG reporting influences supply chain risk management and resilience across different organizational context.

4 Research findings and discussion

This chapter presents the empirical key findings of the study and discusses them in relation to the research questions. The analysis is based on four case companies: Neste, UPM, Wärtsilä, and KONE, whose annual reports, sustainability reports, and other ESG related disclosures form the primary data of the study. The chapter examines how these companies identify, disclose, and manage supply chain risks through ESG reporting, as well as how these practices relate to supply chain resilience. The findings are first presented at the company level and then compared across cases and linked to theory earlier addressed in the theoretical background part of this study, to identify common patterns and key differences.

4.1 Neste

Neste Corporation operates one of the most complex global supply networks in the renewable energy industry, sourcing waste, residues, and bio-based feedstocks from more than thirty countries (Neste, 2024a). As a producer of renewable diesel and sustainable aviation fuel, the company's business model is inherently exposed to environmental, geopolitical, and market related risks. Neste therefore relies heavily on ESG reporting to govern sustainability performance, identify emerging risks, and strengthen supply chain resilience across its global operations (Neste, 2023). ESG reporting serves as an integrative mechanism linking strategic planning, financial management, and supply chain governance, enabling Neste to operate effectively in a rapidly evolving regulatory and environmental landscape (Neste, 2024a).

Neste structures its ESG reporting in line with established frameworks such as GRI, SASB, and TCFD, while aligns with the CSRD/ESRD requirements that have been implemented from 2024 and further reflected in its 2025 reporting (Neste, 2025a). This approach supports consistent and structured disclosures on key areas including climate risks, human rights assessments, biodiversity impacts, and supply chain traceability challenges. Double materiality assessments based on stakeholder surveys, investor feedback, NGO

consultations, and internal risk analyses help identify sustainability issues most relevant to supply chain continuity (Neste, 2025a).

Neste's governance processes institutionalize ESG risk analysis: cross-functional risk teams evaluate climate science, geopolitical scenarios, commodity price volatility, and regulatory developments to determine supply chain exposure to physical climate risks, feedstock shortages, and policy shifts in biofuel mandates and carbon pricing (Neste, 2024a). These insights are reviewed by a Board-level Sustainability Committee, which provides oversight and directs mitigation strategies ensuring that supply chain vulnerabilities identified through ESG reporting are integrated into strategic decision making (Neste, 2024a).

As the figure 2 illustrates Neste's key sustainability priorities, which focus on climate, biodiversity, human rights, and responsible supply chain management. These areas reflect the company's strategic approach to ESG integration, highlighting its commitment to achieving a carbon neutral value chain, promoting biodiversity, ensuring fair labor practices, and strengthening sustainability across its global supply chain (Neste, 2024a).

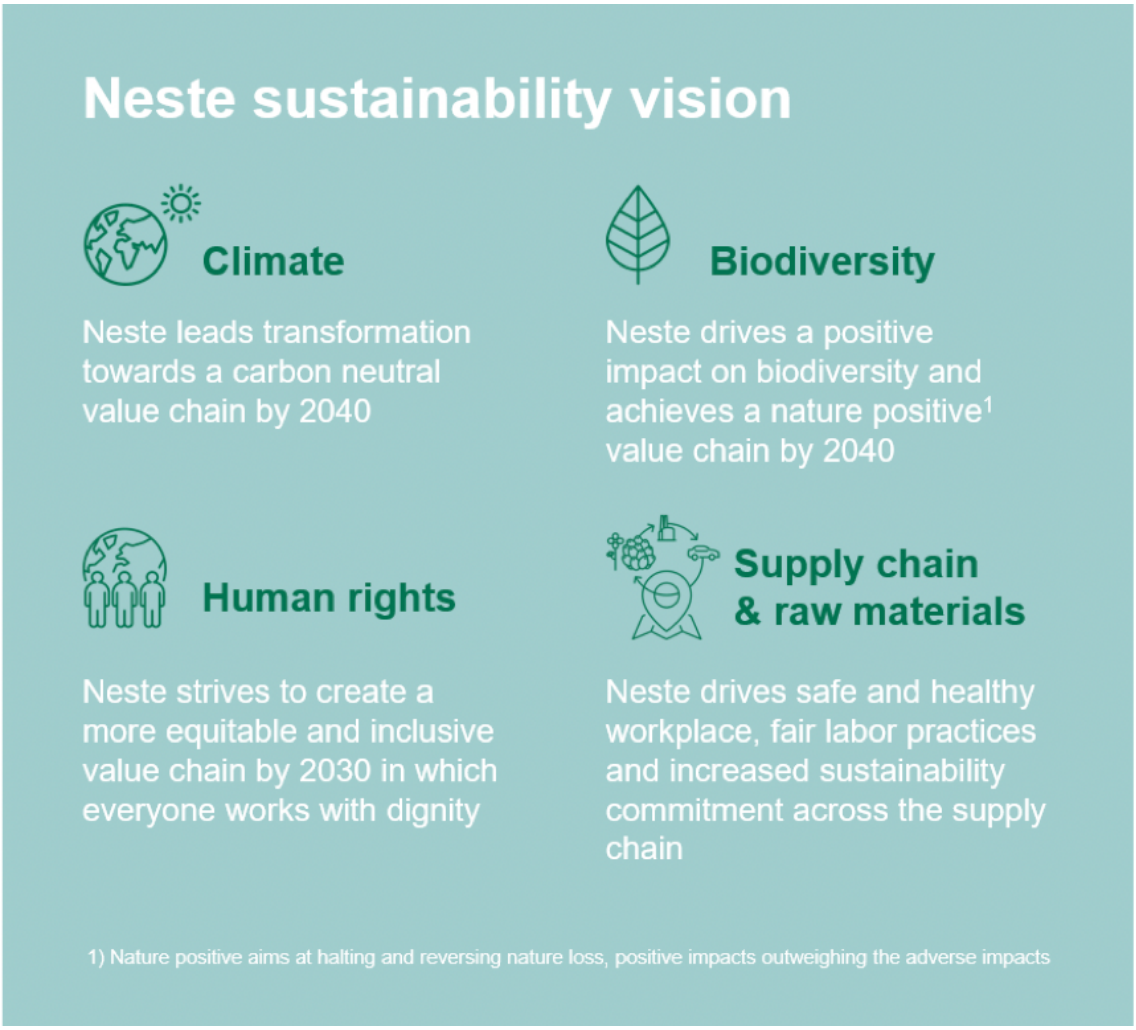

Figure 2 Neste's sustainability vision (Neste, 2025d).

4.1.1 Supply chain risks identified through ESG reporting at Neste

Neste's ESG disclosures highlight a set of supply chain risks that closely align with those most frequently addressed in global sustainability frameworks. These risks reflect the complexity of the company's renewable feedstock supply chains and underscore the importance of systematic ESG reporting as a mechanism for upstream risk identification.

Environmental risks represent one of the most critical areas in Neste's supply chain. Climate related factors, such as extreme weather conditions and longer-term changes in agricultural productivity, can directly affect the availability of feedstocks used in production (Neste, 2025a). Biodiversity loss and broader ecosystem degradation create

challenges, especially in regions supplying bio-based raw materials, where unsustainable land management can affect both environmental integrity and long-term sourcing potential (Neste, 2025a). Concerns related to land use and deforestation are also central, as sourcing decisions must ensure that raw materials are not linked to harmful land conversion. These environmental factors highlight the importance of ESG reporting in identifying high-risk sourcing areas and materials, allowing the company to address potential disruptions before they impact supply continuity (Neste, 2025a).

Alongside environmental issues, Neste faces pronounced social risks within its global supplier network. These include the possibility of forced labour, exploitation, or unsafe working conditions among upstream suppliers, particularly in high-risk regions or among smallholder farmers (Neste, 2024b). Social vulnerabilities are often compounded in supply chains involving informal labour or weak labour governance systems, making human rights due diligence essentials for sustainable sourcing. Furthermore, local conflicts over land rights and community relations can introduce socio-political instability that directly affects raw material supply. Neste's reporting acknowledges these vulnerabilities and incorporate them into broader assessments of social sustainability risks across the value chain, particularly in high-risk regions, this includes supplier assessments, audits, and corrective action plans aimed preventing forced labour, unsafe working conditions, and other human rights violations (Neste, 2024b). These practices are aligned with international guidelines and support identification and mitigation of social risks within complex supply chains.

A third category of concern involves governance risks, especially those related to traceability, fraud, and regulatory compliance. Because a significant portion of Neste's feedstocks originates from waste, residues, and global bio-based streams, the potential for corruption or false information appearing in documentation chains (Neste, 2024b). Problems such as not meeting sustainability certification rules or having weak governance systems at the supplier level can also create challenges. These issues may damage product quality and lead to reputational or legal consequences for Neste. ESG reporting helps

reveal these weaknesses by giving clear information about supplier supervision, certification results, and systems for reporting concerns.

Neste's ESG reporting also describes several operational risks that are typical in the renewable energy supply chain. These include difficulties in securing enough feedstock because supply levels often change and because many companies compete for the same waste and residue materials (Neste, 2024a). Dependence on specific regions for key materials increases the risk of disruption, especially if these areas face political problems or lack strong infrastructure. International tension and delays in global transportation can also affect the steady flow of materials, making it important for Neste to remain flexible in its sourcing strategies and diversifying its supplier base (Neste, 2025a). Neste emphasizes full traceability of its renewable raw materials as a key mechanism for managing supply chain risks. According to Neste (2025a), the company uses certification schemes such as ISCC (International Sustainability and Carbon Certification) to verify that feedstocks meet strict sustainability criteria and can be traced back to their origin. This approach helps reduces governance risks related to fraud, incorrect documentation, and non-compliance, while also improving transparency across the supply chain.

Overall, these environmental, social, governance, and operational risks show how many different factors Neste must manage to keep its supply chain stable. Their inclusion in Neste's ESG reporting demonstrates how sustainability frameworks help identify risk patterns early, support proactive planning, and strengthen overall resilience.

4.1.2 Risks disclosed and managed in Neste's ESG reporting

Neste discloses supply chain risks through structured ESG reporting aligned with international frameworks, ensuring transparency and comparability. Risks are communicated through sustainability reports, annual reports, and dedicated climate disclosures, where environmental, social, and governance risks are systematically categorized and assessed (Neste, 2024a).

Risk management is embedded into governance structures. Neste applies cross-functional risk management processes where ESG related risks are evaluated through scenario analysis, supplier assessments, and continuous monitoring systems (Neste, 2024a). These processes include supplier due diligence and auditing systems, certification schemes (e.g., ISCC), traceability systems for raw materials, and grievance and reporting mechanisms. Board level oversight further strengthens governance, as the Sustainability Committee reviews ESG risks and ensures that mitigation strategies are integrated into corporate decision making (Neste, 2024a). Neste uses digital tools and traceability systems to improve visibility across supply chains, enabling earlier identification of risks and more effective monitoring of supplier compliance, which leads faster response to disruptions (Neste, 2024b). According to Neste (2024a), suppliers are required to adhere to the company's Supplier Code of Conduct, and non-compliance may lead to corrective actions or termination of supplier relationship. This demonstrates how ESG reporting is translated into practical risk management actions within the supply chain.

4.1.3 The relationship between ESG reporting and supply chain resilience at Neste

Neste's ESG reporting demonstrates a clear link between sustainability practices and supply chain resilience. By identifying environmental, social, and governance risks early, ESG reporting enables proactive risk management and strengthens preparedness for disruptions (Neste, 2023). In practice, this is reflected in measures such as improving traceability, supplier diversification, and sustainability certification. These approaches reduce reliance on high-risk suppliers and regions. ESG reporting also supports resilience by enhancing transparency and coordination across supply chain partners, which improves response capabilities during disruptions.

Neste integrates climate related risk scenario analysis into its ESG reporting in line with TCFD recommendations. The company evaluates both physical risks, such as extreme weather events, and transition risks, such as regulatory changes and carbon pricing (Neste, 2024a). These analyses support long-term planning and enable the company to anticipate disruptions, thereby strengthening supply chain resilience. Climate related

disclosures further support resilience by enabling scenario based planning and long-term risk assessment. This allows Neste to anticipate future disruptions and adapt its sourcing strategies, accordingly, strengthening its ability to maintain operational continuity.

To mitigate supply risks, Neste emphasizes diversification of feedstock sources across different regions and supplier types. According to Neste (2024a), reliance on waste and leftover raw material requires a broad supplier base to ensure supply durability. Diversification reduces dependency on specific regions and improves the company's ability to respond disruptions, contributing directly to supply chain resilience.

Neste's ESG reporting also provides concrete evidence of how sustainability risks are identified and managed in practice. In 2025, the company conducted a total of 36 sustainability audits, including 22 audits on renewable and recycled raw material suppliers, 6 on terminals, and 8 on contractors (Neste, 2025c). The results of these audits indicate that most identified issues were related to human and labour rights, highlighting the importance of managing social risk within global supply chains. These findings demonstrates that ESG reporting is not limited to disclosure purposes but actively supports risk identification and ongoing monitoring.

4.1.4 Integrating ESG reporting into Neste's strategic supply chain risk management

Neste's practice shows how ESG reporting can be effectively embedded into strategic SCRM. ESG data is used not only for disclosure but also for decision making, guiding sourcing strategies, supplier selection, and investment planning (Neste, 2024a). The use of double materiality assessment ensures that both financial risks and sustainability impacts are considered in risk management processes. This enables a more comprehensive understanding of supply chain vulnerabilities and supports prioritisation of mitigation actions.

Moreover, integrating ESG reporting with governance structures, digital monitoring systems, and supplier engagement practices allows organisation to move from reactive risk management to proactive and strategic risk mitigation. Neste demonstrates that ESG reporting can function as a central mechanism linking risk identification, governance, and resilience building within global supply chains.

4.2 UPM

UPM integrates ESG reporting into its core procurement and supplier-management process to strengthen risk visibility, preventive control, and adaptive capacity across its extensive global network. The company's Sustainability Statement, part of its annual reporting, and its dedicated sustainability data hub operationalize ESG governance through measurable targets, transparent data, and risk mitigation mechanisms (UPM, 2024a). These structures ensure that sustainability principles are embedded within corporate decision making and supply chain risk management (UPM, 2024a).

UPM reports in accordance with the CSRD and maintains a GRI context index (UPM, 2024b). It also conducts an annual Double Materiality Assessment to evaluate both sustainability impacts and financially material risks, including those associated with the supply chain (UPM, 2024b). This assessment ensures that critical issues such as climate transition, biodiversity protection, and sourcing risks are systematically integrated into enterprise risk management and strategic planning (UPM, 2024b).

The Figure 3 illustrates how UPM aligns its ESG ambitions with supply chain. Each part of ESG is connected to specific supply chain priorities, such as climate action, biodiversity protection, resource efficiency, decent work, and ethical business conduct. The lower rows highlight risk mitigation and compliance measures that ensure sustainability integration throughout the value chain.

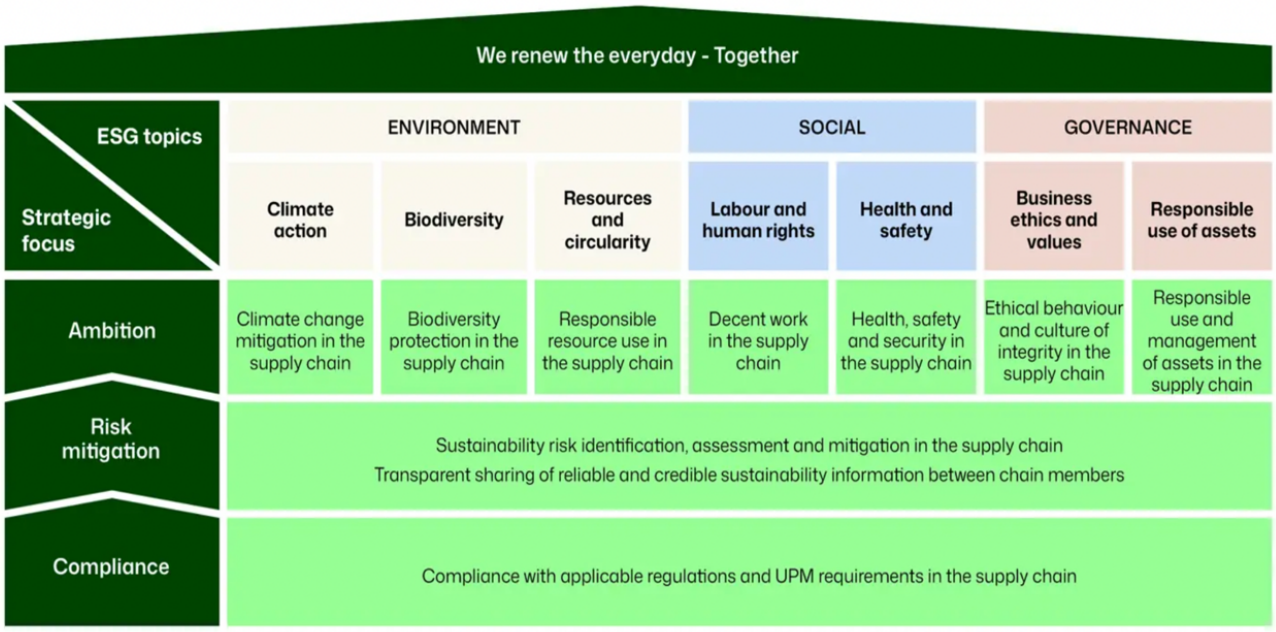

Figure 3 UPM-Kymmenen Oyj. Sustainable supply chain. (UPM, 2024e).

4.2.1 Supply chain risks identified through ESG reporting at UPM

UPM sources from over 22 000 B2B suppliers and approximately 15 000 private forest owners globally, exposing the company to diverse regional, commodity, and labour related risk (UPM, 2024d). Consequently, UPM conducts continuous human rights due diligence as part of its risk management framework, emphasizing areas such as forced labour, migrant worker vulnerability, and occupational safety (UPM, 2024d). This systematic process enhances compliance with international human rights standards while supporting continuity of supply (UPM, 2024d).

Environmental risks include biodiversity loss, climate transition risks, and resource related challenges associated with forestry and raw material sourcing (UPM, 2024b; 2024f). though its Responsible Fibre™ programme, UPM verifies the legal origin of wood and ensures compliance with biodiversity and land use requirements, reducing risks related to illegal sourcing and environmental non-compliance (UPM, 2024f). Social risks are particularly linked to human rights issues such as forced labour, migrant worker vulnerability, and occupational safety concerns within global supplier networks (UPM, 2024d).

Governance risks relate to supplier compliance, ethical business conduct, and adherence to sustainability standards, while operational risks arise from supplier dependency, regional instability, and disruptions in raw material availability.

To manage sustainability related risks, UPM maintains a supply chain ESG Risk Register consolidating risk data across countries, commodities, and sectors (UPM, 2023a). The register classifies contingency plans for high-risk suppliers and classifies risks by severity and like hood (UPM, 2023a). These mechanisms enable rapid mitigation responses, including alternative sourcing and targeted remediation (UPM, 2023a). For critical sectors such as forestry and mining, UPM extends assessments several tiers deeper to strengthen traceability and preparedness (UPM, 2023a).

4.2.2 Risks disclosed and managed in UPM's ESG reporting

The UPM Supplier and Third-Party Code, complemented by detailed guidelines, sets minimum ESG performance expectations for all suppliers and intermediaries (UPM, 2024c). The Code is applied during supplier onboarding and throughout ongoing collaboration, enabling early detection and mitigation of partner related risks before contracts are finalized (UPM, 2024c). This proactive approach helps stabilize UPM's upstream supplier base and reduces the likelihood of supply interruptions or reputational damage (UPM, 2024c).

UPM requires all new suppliers to undergo ESG risk screening before onboarding, where country risk, industry risk, and supplier specific ESG risks are evaluated. High-risk suppliers are subjected to enhanced due diligence and may require corrective actions before approval (UPM, 2024c). UPM conducts continuous human rights examination as part of its risk management framework, ensuring compliance with international standards while supporting supply continuity (UPM, 2024d). UPM conducts on-site supplier audits focusing on human rights, safety, and environmental performance. In high-risk regions, suppliers are audited more frequently, and non-compliances require corrective action plans that are monitored util completion (UPM, 2024d).

UPM's Sustainable Supply Chain Programme links supplier compliance, risk mitigation, and collaboration with long-term sustainability targets and KPIs (UPM, 2024e). A central objective is to achieve 100 percent responsibly qualified material spent by 2030 in line with the Supplier and Third-Party Code (UPM, 2024e). By transforming policy commitments into measurable KPIs, UPM aligns daily procurement decision with resilience outcomes, thereby reducing disruptions caused by non-compliance or limited supplier maturity (UPM, 2024e). The company's Responsible Fibre™ criteria and sourcing frameworks specify raw-material requirements and audit procedures tailored to forestry-based operations (UPM, 2024f). These standards enhance traceability, confirm legal origin, and mitigate biodiversity related risks (UPM, 2024f). Integrating such practices into ESG reporting and supplier audits lowers the probability and severity of environmental or operational disruptions (UPM, 2024f).

UPM provides detailed, site-level reporting on environmental and social performance across its production facilities, including data emissions, waste, and material consumption (UPM, 2025c). This level of detail makes it easier to identify potential operational issues, such as energy or water use inefficiencies, that could escalate into larger supply chain challenges (UPM, 2024g). At the same time, continuous monitoring and reporting support ongoing learning and improvement, allowing company to adjust practices and strengthen its preparedness for potential disruptions (UPM, 2025c).

4.2.3 ESG reporting and supply chain resilience relationship at UPM

At UPM, ESG reporting is not treated only as a reporting obligation but is closely linked to how risks are managed in practice. The company uses tools such as supplier codes of conduct, ESG risk registers, due diligence processes, and performance indicators to support decision-making and strengthen governance (UPM, 2025a). These practices make it possible to identify and categories suppliers based on their ESG risk profile, including across multiple tiers of the supply chain (UPM, 2025a). In addition, they provide a basis

for developing contingency plans for higher-risk suppliers, which helps reduce the likelihood and impact of potential disruptions (UPM, 2023a).

Sustainability targets are also connected to procurement activities through measurable KPIs, which helps align day to day sourcing decisions with broader risk management objectives (UPM, 2025b). At the operational level, detailed site-level monitoring makes it easier to detect inefficiencies or emerging issues, such as those related to energy or resource use, before they escalate into larger problems affecting the supply chain (UPM, 2025c).

UPM also links sustainability performance with financing through instruments such as green finance, which strengthens accountability and supports long-term stability (UPM, 2025a). Taken together, these practices show that ESG reporting plays an active role in managing risks rather than simply describing them. In this way, it supports the company's ability to prepare for disruptions, respond when they occur, and recover more effectively across its global supply network.

4.2.4 Integrating ESG reporting into UPM's strategic supply chain risk management

UPM connects sustainability closely with its financial practices, for example through green bonds and sustainability linked loans under its Green Finance Framework (UPM, 2025a). This approach ties sustainability performance to financing conditions, which encourages consistent governance and increases accountability towards investors and other stakeholders (UPM, 2025a). At the same time, linking ESG performance with financial instruments support long-term stability, especially in situations where markets are uncertain or volatile (UPM, 2025a).

In its investor communications, UPM also highlights several external risks that can affect supply chain continuity, such as climate change, geopolitical developments, regulatory changes, and fluctuations in raw material prices (UPM, 2025a). ESG reporting and related

due diligence processes help the company address these risks by improving visibility across the supply chain and strengthening supplier preparedness (UPM, 2025b).

UPM's practices illustrate how ESG reporting can move beyond basic disclosure. It has been integrated part of broader risk management and decision-making processes. By combining governance structures, supplier engagement, and financial mechanism, ESG reporting supports more stable and resilient supply chain operations over the long term.

4.3 Wärtsilä

Wärtsilä Corporation integrates ESG reporting closely into its enterprise risk management and supply chain governance strategy. Based on the company's sustainability disclosures, particularly its Sustainability Reports 2024 and 2025 and Annual Reports 2024 and 2025, sustainability related disclosures are clearly connected to how risks are identified and managed in everyday operations (Wärtsilä, 2024a; Wärtsilä, 2025a). The company highlights transparency, responsible business conduct, and environmental performance across its global supply network, which includes more than 18 000 suppliers operating in different regions (Wärtsilä, 2024a; Wärtsilä, 2025a).

Wärtsilä's ESG reporting is not limited to external communication. The information reported is also used internally to support risk assessment and decision-making. By monitoring supplier related environmental, social, and governance indicators, the company improves visibility across its supply chain and is better able to recognize potential risk areas early on. Measures such as emission tracking, human rights due diligence, and supplier compliance requirements help reduce exposure to disruptions and support more stable operations (Wärtsilä, 2025b).

Linking ESG related data with enterprise risk management also strengthens Wärtsilä's ability to deal with disruptions when they occur. This can be seen in how the company prepares for different types of risk, responds to unexpected events, and maintains continuity in operations.

4.3.1 Supply chain risks identified in ESG reporting at Wärtsilä

These findings illustrate how ESG reporting frameworks help identify key categories of SCR in practice. Wärtsilä identifies key categories of supply chain risk through its ESG disclosures: environmental and climate-related disruptions, human rights and labor practice violations, material sourcing dependency, and governance related compliance risks (Wärtsilä, 2024b). These risks are explicitly mapped in the company's Sustainability Risk Landscape, which categorizes them under environmental (e.g., emissions, resource use), social (e.g., occupational health and safety, diversity), and governance (e.g., supplier integrity, anti-corruption) dimensions (Wärtsilä, 2024b).

Wärtsilä's integration of sustainability performance metrics into operational risk management. Wärtsilä's ESG reporting not only discloses sustainability risks but also functions as a resilience-building mechanism through preventive, adaptive, and restorative capabilities (Wärtsilä, 2024c). From a preventive standpoint, the company uses ESG data to identify systemic risks, such as reliance on high-emission suppliers or regions with political instability, allowing proactive mitigation strategies (Wärtsilä, 2024a). The geographical dispersion of Wärtsilä's supplier base increases exposure to region specific risks such as geopolitical instability, regulatory differences, and environmental conctrants, which are addressed through ESG based risk classification (Wärtsilä, 2024a).

From an adaptive perspective, Wärtsilä's transparent supplier network and data-driven sustainability monitoring enhance agility and enable quick response to disruptions for example, during logistics interruptions or regulatory changes. Finally, from a restorative standpoint, Wärtsilä's governance mechanisms, such as crisis response protocols and supplier requalification processes, ensure that supply-chain operations recover rapidly from environmental or social shocks (Wärtsilä, 2024b). ESG reporting makes supply-chain resilience more streng by turning sustainability metrics into actionable risk intelligence.

4.3.2 Disclosure and risk management mechanisms at Wärtsilä

This part demonstrates how supply chain risks are disclosed and managed throught ESG reporting at Wärtsilä. Wärtsilä follow a structured ESG reporting frameworks like GRI and TCFD when disclosing sustainability information (Wärtsilä, 2025b). In reports, company presents supplier related indicators, including audit coverage, compliance with the Supplier Code of Conduct, and progress in responsible sourcing. These discloses are closely linked to how supplier risks are managed in practice. ESG requirements are already included in the supplier selection and qualification process, meaning that environmental, social, and ethical criteria must be met before a supplier is approved in company (Wärtsilä, 2025a). In this way, potential risks are addressed at an early stage instead of only reacting to problems later.

Wärtsilä also reports measurable ESG data, such as the share of suppliers committed to its Code of Conduct and the number of audits carried out each year, which makes it possible to follow developments over time (Wärtsilä, 2025a). In addition to this, Wärtsilä conducts regular assessments that look at issues like emissions, safety practices, and working conditions within the supplier network. These activities improve visibility and help identify possible risks before they escalate.

ESG reporting at Wärtsilä is used for more than just communication. It supports continuous monitoring of supplier performance, helps ensure compliance, and provides a basis for corrective actions when needed.

4.3.3 ESG reporting and supply chain resilience relationship

At Wärtsilä's ESG reporting is clearly linked to how the company builds and maintains supply chain resilience. The information collected through ESG processes is not only used for reporting purposes but also supports different stages of risk management, including prevention, response, and recovery (Wärtsilä, 2025a).

From preventive point of view, ESG related data helps recognise potential weaknesses in its supply chain, such as reliance on suppliers with high emissions or operations located in politically unstable regions. Identifying these issues early makes it easier it acts before they develop into more serious disruptions (Wärtsilä, 2025a). In terms of response capability, continuous monitoring of supplier performance and sustainability indicators improves visibility across the network. This makes it easier to react when disruptions occur, for example in cases of logistics delays or sudden regulatory changes affecting sourcing or production (Wärtsilä, 2025b). Recovery is supported through, governance mechanisms such as crisis response protocols and supplier requalification processes and internal procedures for handling disruptions helps with the recovery of supply chain operations after environmental or social shocks (Wärtsilä, 2025b).

Recent reports also point to challenges related to global logistics and the availability of key components, which have increased the importance of supplier diversification and risk monitoring in maintaining operational continuity (Wärtsilä, 2025a). This indicates that ESG reporting strengthens resilience by improving visibility into supply chain risks and turning sustainability related information into practical actions in its supply chain.

4.3.4 Strategic integration of ESG into SCM at Wärtsilä

Wärtsilä's sustainability strategy shows how ESG reporting can be connected to broader business strategy. The company aligns ESG reporting with corporate strategy through its Decarbonization Business Vision and Supplier Sustainability Development Programme (Wärtsilä, 2024c). They are linking its ESG objectives with strategic initiatives such as decarbonization targets and supplier development programmes, which are reflected in its overall operations and SCM (Wärtsilä, 2025a). This integration ensures that supplier development, emissions reduction, and social responsibility are not treated separately but are considered together when managing supply chain risks. In practice, ESG related information is also used to support planning and decision making. Rather than being limited to reporting, the data helps to prepare for different future scenarios, especially in markets where conditions can change fast (Wärtsilä, 2025a).

Wärtsilä connects sustainability with innovation and digitalization, key enablers of resilience. Initiatives such as predictive analytics for supply chain visibility and lifecycle carbon assessment tools enhance transparency and prepare the organization for emerging sustainability regulations (Wärtsilä, 2024a). Wärtsilä also utilizes digital tools and data driven monitoring systems to better their supplier visibility and track sustainability performance, enabling faster identification of potential disruptions (Wärtsilä, 2024a). For example, lifecycle- based carbon assessments and digital monitoring help identify potential issues earlier and support compliance with changing regulatory requirements (Wärtsilä, 2025b). The company's use of supplier sustainability scorecards and regular audits are used in procurement processes to evaluate environmental and social performance. This makes ESG considerations part of everyday sourcing decisions, rather than something that is only reviewed afterwards.

Figure 4 shows Wärtsilä's overall sustainability approach and how it is integrated into the company's strategy and operations. At the top, you can see the company's purpose, which highlights its focus on enabling sustainable societies through innovation setting the foundation for its sustainability strategy. The framework is structured around three main dimensions: economic, environmental, and social. The economic dimension can be seen, as focusing on efficient and competitive operations while meeting stakeholder expectations. The environmental dimensions stand for decarbonization, technological innovation, and environmental performance, reflecting the company's commitment to reducing its climate impact. The social dimension includes ethical standards, employee well-being, diversity, and supply chain development, indicating the importance of responsible business practices.

These all dimensions are supported by corporate values on one side and governance principles, such as the Code of Conduct and corporate policies, on the other. At the bottom, sustainability management practices, including targets, reporting, and stakeholder engagement, show how these strategic elements are implemented in practice. The

figure 4 demonstrates how Wärtsilä embeds sustainability into both strategic decision making and operational processes, linking ESG considerations directly to supply chain management and long-term resilience.

Figure 4 Wärtsilä's sustainability approach (Wärtsilä, 2025b).

4.4 KONE

KONE Oyj, a global leader in elevator and escalator manufacturing, has increasingly embedded ESG reporting as an essential part of its operational strategy and supply chain management (KONE Oyj, 2024a; KONE Oyj 2025a). Through structured sustainability disclosures, KONE enhances its ability to identify, assess, and mitigate risks across its complex multinational supply chain (KONE Oyj, 2023). Through this reporting, KONE can track environmental, social, and governance issues more systematically and link them to its broader risk management. This is important given the company's reliance on a wide and geographically dispersed supplier base. At the same time, ESG reporting helps the

company respond to tightening regulation and changing stakeholder expectations, while also supporting its ability to operate in uncertain global market conditions (KONE Oyj, 2025a).

KONE's ESG strategy directly enhances long term resilience by linking sustainability goals to operational excellence (KONE Oyj, 2024a). The company's commitment to carbon neutrality in operations by 2030 and a 40 percent reduction in value chain emissions by 2030 drives innovation in materials sourcing, logistics, and circular economy practices (KONE Oyj, 2024a). KONE requires key suppliers to align with its emission reduction targets and increasingly prioritises low-carbon materials and energy efficient components in procurement decisions, directly linking ESG goals to sourcing practices (KONE Oyj, 2021a). These targets not only reduce environmental risk exposure but also create adaptive capacity against regulatory and market pressures (KONE Oyj, 2024a).

4.4.1 ESG supply chain risks identified at KONE

KONE's ESG reporting identifies several key categories of supply chain risks that align with broader ESG frameworks. Environmental risks include emissions from materials such as steel and electronics, as well as energy consumption in manufacturing and logistics (KONE Oyj, 2024a). KONE highlights Scope 3 emissions from purchased goods and services as a major risk area, indicating strong dependence on supplier performance in reducing environmental impact (KONE Oyj, 2024b).

In the social and governance dimensions, KONE's ESG reporting outlines programs that minimize labour, ethics, and compliance related risks (KONE Oyj, 2024a). All suppliers must complete ethics and compliance training, reinforcing the company's culture of integrity (KONE Oyj, 2024a). KONE implements human rights due diligence aligned with the UN Guiding Principles on Business and Human Rights, which helps detect and address labour related vulnerabilities early (KONE Oyj, 2024a). A confidential whistleblowing system is available for both employees and suppliers, ensuring transparent handling of ethical violations (KONE Oyj, 2024a). These measures protect the company from

reputational damage, strengthen stakeholder trust, and uphold resilience through consistent ethical governance (KONE Oyj, 2024a).

Climate related risks are particularly relevant due to regulatory changes and carbon pricing mechanisms, which may affect supplier costs and availability of materials (KONE Oyj, 2024b). Social risks are also prominent within KONE's supply chain, including labour conditions and occupational safety in supplier operations. For example, KONE identifies risks related to working conditions in high-risk sourcing regions and addresses these through targeted audits and supplier engagement programmes (KONE Oyj, 2023). Governance risks include supplier compliance, ethical conduct, and anti-corruption practices. A concrete example is the risk of non-compliance with the Supplier Code of Conduct, which may lead to supplier disqualification or contract termination if violations are identified (KONE Oyj, 2023).

4.4.2 Disclosure and risk management at KONE

KONE's ESG reporting adheres to the GRI standards and aligns with the CSRD and ESRS from 2024 onwards (KONE Oyj, 2025). The company also uses the TCFD framework to assess and communicate climate related supply chain risks (KONE Oyj, 2025). These frameworks transform ESG reporting from a compliance obligation into a governance tool that support transparency and accountability across the supply chain (KONE Oyj, 2024a). They provide more structured way to track sustainability related issues and improve transparency and supplier related risks.

Through double materiality assessments, KONE identifies both how its operations impact environmental and social systems and how sustainability issues may affect financial and operational performance (KONE Oyj, 2024a). This dual perspective embeds ESG data into enterprise risk management, allowing the company to anticipate and address supply chain risks related to climate change, evolving regulations, and social responsibility challenges (KONE Oyj, 2024a).

KONE operates a global network of suppliers across more than 50 countries, requiring advanced ESG driven due diligence to manage environmental, ethical, and operational risks (KONE Oyj, 2023). Supplier oversight is conducted through sustainability self-assessments, independent audits, and digital monitoring tools that are fully integrated into the company's ESG reporting process (KONE Oyj, 2023). In 2023, 77 percent of key suppliers underwent sustainability audits, an increase from 73 percent in 2022, demonstrating continuous improvement in supplier oversight (KONE Oyj, 2023). In 2024, KONE further strengthened its approach by expanding supplier sustainability assessments and increasing coverage across Tier-1 suppliers, focusing specifically on high-risk categories such as metals, electronics, and logistics (KONE Oyj, 2024a). The 2024 Sustainability Statement also highlights increased monitoring of supplier carbon performance as part of KONE's value chain emissions requested to set science-based climate targets (KONE Oyj, 2024a).

These audits evaluate compliance with the KONE Supplier Code of Conduct, which includes environmental impact, occupational safety, human rights protection, and anticorruption requirements (KONE Oyj, 2023). The process is risk based: suppliers are prioritized by criteria such as country of operation, environmental footprint, and production criticality (KONE Oyj, 2023). High-risk suppliers are subjected to on-site inspections and must implement corrective actions within defined timeframes (KONE Oyj, 2023). This approach mitigates environmental non-compliance, labour or ethical violations, and potential operational disruptions, thereby increasing supply chain resilience (KONE Oyj, 2023).

Additionally, KONE intensified follow up actions on non-compliant suppliers in 2024 by requiring corrective action plans and conducting re-audits to verify compliance progress, thereby reinforcing ESG based risk mitigation and resilience across the supply chain (KONE Oyj, 2024a).

The following figure 5 illustrates how KONE tracks ESG performance through measurable indicators across environmental, social, and governance dimensions. It shows clear progress in KONE's ESG performance over recent years. In terms of environmental performance, KONE has reduced greenhouse gas emissions from its own operations from earlier levels to a 29% reduction compared to the baseline, showing steady improvement every year previously. Product related emissions have decreased, with reductions improving from around 4-5% in earlier years to over 12%, indicating that sustainability measures are increasingly reflected in product design and lifestyle impacts. Figure % also shows the share of renewable electricity used in KONE's facilities has increased significantly, reaching close to full coverage, which demonstrates a strong shift towards low-carbon operations. As we can see in Figure 5, there has also been improvement in transparency and product related sustainability. The number of products covered by environmental product declarations has increased from 17 to 27, showing clear expansion in the company's efforts to provide measurable environmental information.

In the social dimension, development is more gradual but still visible in Figure 5. For example, the share of woman in director-level positions has increased steadily from around 23% to over 27%, indicating progress towards diversity targets. Occupational safety performance has also shown improvement compared to earlier years, although fluctuations suggest that this are requires continuous attention. Governance related indicators in Figure 5 show particularly strong development. The share of employees completing Code of Conduct training has increased significantly from just over 50% to 95%, reflecting a major improvement in internal compliance awareness. In addition, supplier related governance remains consistently high, with around 87% of supplier spending covered by the Supplier Code of Conduct, indicating stable integrating of ESG requirements into procurement. The share of distributors committed to the Code of Conduct has also increased substantially, rising from around 40% to over 90%, which shows clear progress in extending governance practices across the value chain. These improvements demonstrate how ESG targets are being translated into measurable operational outcomes.

Environmental matters	Greenhouse gas emissions from own operations (Scope 1 and 2) [1]	Long-term target (2030) By the end of 2024	50% reduction in absolute emissions from 2018, carbon neutral operations Carbon neutral manufacturing units	29% reduction compared to 2018. (2024: 110,000 tCO_2e)	25% reduction compared to 2018. (2023: 116,500 tCO_2e) Carbon neutral manufacturing units achieved 18 months ahead of schedule in the end of June 2023.	17% reduction compared to 2018. 2022: 126,700 tCO_2e)
	Product-related greenhouse gas emissions (Scope 3) [1]	Long-term target (2030)	40% reduction in product-related Scope 3 emissions relative to ordered products	12.8% reduction compared to 2018. (2024: 62,2 tCO_2e/order)	5.1% reduction compared to 2018. (2023: 68,2 tCO_2e/order)	4.3% reduction compared to 2018. (2022: 68.3 tCO_2e/order)
	Share of renewable electricity used in our facilities, %	Long-term target (2030)	100%	99%	97%	84%
	Number of products covered by Environmental Product Declarations	By 2023	20	27	21	17
Personnel and social matters	Industrial Injury Frequency Rate (IIFR), employees [2]	Long-term target (2030)	0.6	1.3	1.1	1.4
	Total rolling 12-month turnover rate, % [3]			11.5%	13.1%	7.9%
	Share of women in director level positions, %	Long-term target (2030)	35% of director level positions occupied by women	27.4%	25.2%	23.5%
Business conduct	% of total employees who have completed annual Code of Conduct training during the year (or at least one ethics & compliance training)			95%	85% [4]	53% [5]
	% of KONE's total spend with regular trade suppliers and installation subcontractors that is covered by KONE Supplier Code of Conduct or equivalent accepted by KONE	Target (2024)	87%	87%	86%	86%
	% of distributors who have signed the Distributor Code of Conduct	During 2025	100%	97%	92%	42%

Figure 5 KONE's ESG performance indicators and development over time (KONE Oyj, 2025a).

4.4.3 Strategic integration of ESG into supply chain management at KONE

KONE's ESG reporting emphasizes both quantitative and qualitative transparency to enhance risk forecasting and proactive resilience planning (KONE Oyj, 2024b). The company discloses energy efficiency metrics from manufacturing and logistics operations, which helps identify cost and risk reduction opportunities linked to energy volatility (KONE Oyj, 2024b). It also reports Scope 1, 2 and 3 emissions, thereby extending visibility over upstream supplier and downstream logistics activities (KONE Oyj, 2024b).

KONE integrates ESG considerations into strategic decision making through double materiality assessments, ensuring that both sustainability impacts and financial risks are considered in SCM (KONE Oyj, 2024a). KONE also links sustainability targets directly to procurement decisions. For instance, the company prioritises suppliers that

demonstrates strong environmental performance and low carbon intensity, which reduces long-term regulatory and operational risks (KONE Oyj, 2024a).

Additionally, the Supplier Sustainability Program encourages vendors to share their own ESG targets and performance data and align with KONE's sustainability objectives, creating a cascading transparency effect across multiple supply chain tiers (KONE Oyj, 2024b). This creates a cascading effect, where ESG requirements extend beyond Tier-1 suppliers to deeper levels of the supply chain. This continuous data collection and disclosure enable KONE to model risk scenarios, anticipate disruptions, and design resilient procurement strategies (KONE Oyj, 2024b). ESG data is used in strategic planning and risk assessment. For example, emissions data and energy efficiency indicators from suppliers are used to identify potential cost risks related to energy price volatility and regulatory changes (KONE Oyj, 2024b).

4.4.4 ESG reporting as a mechanism for SCR at KONE

KONE's ESG reporting contributes directly to supply chain resilience by improving transparency and enabling early risk detection (KONE OYj, 2024b). For example, continuous monitoring of supplier ESG performance allows KONE to identify risks such as non-compliance, high emissions, or operational inefficiencies before they lead to supply disruptions (KONE Oyj, 2024b). The company's use of Scope 1,2, and 3 emissions reporting provides visibility across the entire value chain, allowing KONE to anticipate climate related disruptions and adjust sourcing strategies accordingly (KONE Oyj, 2024b).

Supplier diversification and risk-based sourcing further strengthen resilience. By reducing dependence on individual suppliers or regions, KONE improves its ability to respond to disruptions such as geopolitical instability or logistics delays (KONE Oyj, 2023). Social and governance mechanisms also supports resilience. For instance, KONE's whistleblowing system and mandatory ethics training for suppliers help identify and address ethical risks early, preventing reputational damage and supply chain instability (KONE Oyj, 2024a). KONE demonstrates how ESG reporting can be used as a practical tool for

transforming sustainability data into actionable insights, supporting proactive risk management, and strengthening supply chain resilience.

4.5 Cross-case comparison of ESG reporting and SCRM

Neste emphasises climate-related risks and feedstock availability, while UPM focuses more on biodiversity and sustainable forestry practices. Wärtsilä and KONE, in turn, highlight emission and material-related risks, especially linked to industrial production and global sourcing. Across all companies, the most frequently addressed supply chain risks include environmental risks (such as climate change and resource availability), social risks (Such as labour conditions and human rights), and governance related risks (such as supplier compliance and transparency). This indicates that ESG reporting frameworks consistently emphasise similar categories of supply chain risks, even though the specific focus varies depending on industry context.

As trying find similarities across all companies, there is the use of supplier codes of conduct, sustainability audits, and risk-based supplier assessments. For example, KONE reports that 77% of key suppliers were audited, while UPM and Wärtsilä apply similar audit-based control mechanisms. While Neste complements these practices with strong traceability systems for feedstock sourcing. In terms of disclosure, all companies report ESG related risks through structured sustainability reports that align with frameworks such as GRI, TCFD, and ESRS. Disclosures are including both qualitative descriptions of risks and quantitative indicators, such as emissions data, supplier audit coverage, and sustainability targets. Despite these similarities, there can be found differences in where the focus is at. Neste stands out for its use of TCFD, while UPM demonstrates a more structured approach through ESG risk registers and multi-tier supplier assessments. Wärtsilä put its focus strongly on integrating ESG metrics into operational risk management, while KONE emphasises continuous monitoring and supplier compliance processes.

Across all case companies, ESG is increasingly part of core decision making rather than treated as a separate sustainability function. ESG considerations are embedded into procurement processes, supplier selection, and long-term planning. One clear similarity is the use of double materiality assessments, which helps companies connect sustainability issues with both business risks and broader societal impacts. This makes it easier to identify the most critical supply chain risks and to reflect them in strategic decisions. At the same time, differences emerge in how deeply ESG is integrated in these processes across the companies. Neste shows strong integration at the strategic level, with ESG governance linked to board-level decision making and long-term scenario planning. UPM and Wärtsilä integrate ESG into operational risk management and supplier governance structures. KONE, on the other hand, demonstrates integration through its supplier sustainability programme and procurement practices. These findings suggest that effective integration of ESG into SCRM requires both strategic level commitment and operational level implementation mechanisms.

A key similarity is that ESG reporting enables early identification of risks, allowing companies to take preventive actions before disruptions occur. For example, supplier audits and monitoring systems help detect compliance issues, while emissions data and climate reporting support long-term risk assessment. Resilience is also strengthened through supplier diversification, traceability, and collaboration, which are supported by ESG reporting processes. Neste's diversification of feedstock sources, UPM's multi-tier supplier monitoring, and KONE's risk-based supplier management are clear examples of this. Differences are mainly related to the type of resilience capabilities emphasised. Neste focuses on anticipation and long-term adaption, particularly through climate scenario analysis. Wärtsilä and KONE emphasise operational resilience, such as rapid response and recovery through monitoring and governance mechanisms. UPM combines both perspectives through structured risk management and supplier engagement. These findings indicate that ESG reporting acts as a key mechanism for building supply chain resilience, particularly by improving transparency, coordination, and proactive risk management.

4.6 Discussion and interpretation of results

This study examined how ESG reporting is used as a mechanism for identifying and managing supply chain risks and how it contributes to supply chain resilience. The findings from Neste, UPM, Wärtsilä, and KONE indicate that ESG reporting is no longer used only for external communication but has become embedded part of how companies' mange risks and make strategic decisions. This shift can be seen in how sustainability related information is applied in areas such as procurement and supply chain management. As Truant et al. (2024) argue, ESG practices are becoming more integrated across supply chain functions, although the level of implementation still varies between organisations.

4.6.1 Supply chain risk addressed in ESG reporting frameworks

Regarding the first research question, the findings show that ESG reporting frameworks are consistently used to identify environmental, social and governance related risks. In practice, these include issues such as climate related risks, resource availability, labour conditions within supplier networks, and supplier compliance challenges. This supports the classification presented by Shekarian and Mellat Parast (2021), who group supply chain risks into these broader categories.

At the same time, the results indicate that the relative importance of these risks depends strongly on the company's industry and supply chain structure. For example, Neste places strong emphasis on climate risks and renewable feedstock availability, reflecting the nature of its business. In contrast, UPM focuses more on biodiversity and sustainable forestry related risks, which are directly linked to its raw material base. More recent company reporting also suggests that regulatory pressures, such as stricter climate and sustainability requirements introduced in recent years, have further increased the focus on environmental risks across industries.

While ESG frameworks provide a common structure for identifying risks, companies adapt them to their specific ways depending on their operational context. This suggests that ESG reporting is not a one size approach that automatically fits all, but rather something that is adapted to the specific characteristics and risk profiles of each supply chain.

The table 1 summarizes the main ESG related supply chain risks identified across the case companies. This table I have based on the information collected from their sustainability and annual reports. The results show that environmental, social, and governance risks are consistently recognized, although their relative importance varies depending on differing industry context.

	Main environmental risks	**Main social risks**	**Main governance risks**	**Supply chain specific risks**
Neste	Climate change impacts on feedstock availability, land use change, biodiversity risks	Human rights risks in global sourcing, smallholder supply chains	Traceability challenges, certification compliance, fraud risks	Dependence on waste and residue-based feedstocks, global sourcing complexity
UPM	Biodiversity loss, sustainable forestry risks, resource efficiency	Labor conditions in forestry and supplier network	Supplier compliance, ethical sourcing, regulatory requirements	Large supplier base across forestry and raw materials, multi-tier sourcing risks
Wärtsilä	Emissions, energy use, environmental impact of industrial production	Occupational safety, labor standards in supplier network	Supplier integrity, anti-corruption, compliance risks	Global supplier network, dependency on critical components and logistics
KONE	Emissions from materials and logistics, energy efficiency	Labor practices, supplier working conditions	Supplier compliance, ethics, anti-corruption	Dependence on global suppliers (metals, electronics), logistics disruptions

Table 1 ESG related supply chain risks identified

4.6.2 Disclosing and managing supply chain risk through ESG reporting

The second research question examined how companies disclose and manage supply chain risks through ESG reporting frameworks such as GRI, TCFD, and ESRS to communicate sustainability related risks. According to Shekarian and Mellat Parast (2021) SCRM consist of structured processes through which organisations identify, evaluate, and mitigate risks across supply networks. The practices observed in the case companies reflect this theoretical perspective. For instance, supplier audits, codes of conducts, and double materiality assessments are used to identify and evaluate risks, while mitigation strategies include supplier diversification, traceability systems, and sustainability requirements. These findings are consistent with the view presented by Shekarabi et al. (2025), who state that effective risk mitigation in supply chains relies on mechanisms such as flexibility, collaboration, and proactive risk management practices.

ESG related tools such as supplier monitoring, and traceability can be seen as concrete implementations of these mitigation strategies. Dolgui and Ivanov (2021) explains that disruptions in supply chains can propagate across interconnected networks, which increases the importance of continuous monitoring and visibility. As we can see in this study the case companies' use of ESG reporting to track supplier performance and sustainability indicators supports this perspective by improving transparency and enabling earlier detection of potential disruptions. For example, UPM's multi-tier supplier evaluations and Neste's traceability systems demonstrate how companies attempt to manage risks beyond their immediate suppliers. These practices are in line with earlier research suggesting that organizations with more developed ESG approaches tend to have stronger resilience capabilities (Christopher & Peck, 2004; Yuan et al., 2025).

The table 2 presents how ESG reporting is used to identify, manage, and monitor supply chain risks in practice. It demonstrates that ESG reporting frameworks are closely linked to operational risk management processes, including supplier audits, monitoring systems, and mitigation strategies.

	ESG disclosure approach	Risk identification methods	Risk mitigation practices	Monitoring and control mechanisms
Neste	Uses GRI, SASB, TCFD; strong focus on traceability and climate reporting	Double materiality assessment, supply chain mapping, scenario analysis	Feedstock diversification, certification systems, supplier requirements and code of conduct	Traceability systems, sustainability data reporting, supplier monitoring and audits
UPM	CSRD-aligned reporting, GRI index, sustainability data hub	ESG risk register, double materiality, supplier assessments	Supplier code of conduct, multi-tier risk assessment, responsible sourcing programs	Continuous monitoring, supplier audits, site-level reporting
Wärtsilä	GRI and TCFD aligned ESG reporting integrated into risk management	Sustainability risk landscape, double materiality, ESG metrics, supplier evaluation	Supplier qualification and code of conduct, emissions targets, governance controls	Supplier audits, ESG KPIs, operational monitoring systems
KONE	GRI, TCFD, CSRD/ESRS aligned reporting	Double materiality, supplier risk classification, sustainability assessments	Supplier code of conduct, corrective actions, sustainability programs	Supplier audits, digital monitoring tools, performance tracking

Table 2 ESG disclosure and risk management practices

4.6.3 The relationship between ESG reporting and supply chain resilience

The third research question addressed the relationship between ESG reporting and supply chain resilience. The findings strongly support the view that ESG reporting contributes directly to resilience capabilities. According to Christopher and Peck (2004), resilience involves the ability to prepare for, respond to, and recover from disruptions. In the results of this study all these dimensions are demonstrated. Neste's use of climate scenario analysis enhances preparedness, while KONE's and Wärtsilä's monitoring systems improve response capabilities. As Shekarabi et al. (2025) state, resilience is built through interconnected capabilities such as preparedness, response, recovery, and adaption, and ESG reporting appears to support each of these processes. All the practices address in

these companies such as supplier diversification, traceability, and collaboration reduce vulnerability and improve companies' ability to adapt to disruptions, which is consistent with the capability-based perspective presented by Pettit et al. (2013).

The findings of this study show that companies emphasize different aspects of resilience. Neste focuses more on long-term adaption and anticipation, particularly in relation to climate risks, where Wärtsilä and KONE prioritize operational resilience through monitoring and governance mechanisms. UPM combines both approaches by integrating ESG into both strategic planning and operational risk management. As Shekarabi et al. (2025) note, resilience is not a single capability but a combination of processes that vary depending on organizational context. The differences observed in the case companies in this study support this view.

The table 3 highlights the relationship between ESG reporting and supply chain resilience across the case companies. It shows that ESG practices contribute to different dimensions of resilience, including preparedness, response, and adaption, depending on company context.

	Key resilience focus	ESG contribution to resilience	Example from case	Type of resilience
Neste	Anticipation and long-term adaptation	Climate scenario analysis and feedstock diversification improve preparedness	Diversified sourcing + climate scenario analysis supporting long-term planning	Strategic / anticipatory resilience
UPM	Combined strategic and operational resilience	ESG risk registers and supplier monitoring improve planning and response	Multi-tier supplier assessment + 97% low-risk supplier classification	Mixed resilience approach
Wärtsilä	Operational response and recovery	ESG metrics and supplier governance improve rapid response to disruptions	Supplier qualification and integrated ESG risk monitoring systems	Operational resilience
KONE	Monitoring and response capability	Continuous supplier audits and data transparency, measurable ESG indicators supports continuous monitoring and support fast reaction	Continuous supplier audits (77% audit coverage) + corrective action plans improving response	Operational resilience

Table 3 ESG and supply chain resilience relationship

4.6.4 Integrating ESG reporting into strategic supply chain risk management

The fourth research question explored how ESG reporting can be integrated more effectively into strategic SCRM. The findings in this study suggest that effective integration requires both strategic level alignment and operational implementation. ESG is most effective when it's embedded into core business processes such as procurement, supplier selection, and risk management systems. As truant et al. (2024) argue, ESG practices need to be integrated across supply chain tier to achieve meaningful impact. The results that study has gave about these companies demonstrates this by linking ESG reporting to decision making processes, performance measurement, and supplier governance. As an example, ESG metrics and supplier requirements are for helping and guiding with operational decisions alongside fulfilling the reporting requirements.

The findings highlight there is still several challenges related to ESG integration. Although ESG reporting improves transparency and risk identification, managing risks across global supply chains remains complex. Differences in supplier capabilities, data availability, and regulatory environments limit the effectiveness of ESG based risk management. As Truant et al. (2024) point out, ESG implementation across supply chain is this fragmented, which can reduce the overall effectiveness of sustainability initiatives.

As a conclusion, the findings in this study confirm that ESG reporting, and supply chain resilience are strongly and extremely closely interconnected. ESG reporting enhances transparency, supports systematic risk identification, and improves coordination across supply chain actors. At the same time, resilience ensures that sustainability objectives can be maintained even under disruption. As Christopher and Peck (2004) and Shekarabi et al. (2025) emphasise, resilience is built through capabilities that enable organisations to anticipate, respond to, and recover from disruptions. The empirical results confirm that ESG reporting plays a central role in developing these capabilities, indicating that ESG and resilience should be understood as mutually reinforcing element within modern supply chain management.

The table 4 illustrates how ESG is integrated into supply chain management at both strategic and operational levels. The findings indicate that ESG is embedded into core business processes such as procurement, supplier governance, and risk management rather than treated as a separate reporting function.

	Strategic integration	Operational integration	Key tools used	Level on integration
Neste	ESG integrated into board-level decision making and long-term planning	Embedded in sourcing strategy and supplier selection	Scenario analysis (TCFD), traceability systems, sustainability certifications	Strong strategic integration
UPM	ESG integrated into corporate strategy and risk management systems	Embedded in procurement, supplier governance, and operations	ESG risk register, supplier programs, KPIs	Balanced strategic and operational integration
Wärtsilä	ESG linked to enterprise risk management and operational performance	Integrated into supplier evaluation and operational processes	ESG metrics, supplier qualification, governance mechanisms	Strong operational integration
KONE	ESG linked to sustainability strategy and performance targets	Embedded in supplier management and procurement processes	Supplier audits, digital monitoring, sustainability KPIs, supplier emissions reporting & science-based targets	Strong operational and process-level integration

Table 4 ESG integration into supply chain management

5 Conclusion

This study explored how ESG reporting is used in practice to identify and manage supply chain risks and how it contributes to supply chain resilience. By analysing the ESG disclosures of Neste, UPM, Wärtsilä, and KONE, the study aimed to better understand how sustainability reporting is connected to operational risk management within global supply chains.

The findings show that ESG reporting has clearly moved beyond its original role as a communication tool. In all case companies, ESG is embedded in core processes such as supplier selection, procurement, and risk management. As the results indicate, companies systematically identify environmental, social, and governance related risks through ESG frameworks, but the emphasis varies depending on the industry. For example, Neste focuses strongly on climate risks and feedstock availability, while UPM highlights biodiversity and forestry related risks, and Wärtislä and KONE emphasise emissions, materials, and supplier compliance. This supports earlier literature suggesting that while ESG frameworks provide a common structure, their application is context specific.

Above that the study shows that ESG reporting plays a practical role in managing supply chain risks. Tools such as supplier audits, codes of conduct, traceability systems, and double materiality assessments are not only used for reporting but also for continuous monitoring and risk mitigation. In this sense, ESG reporting can be seen as a practical way to put supply chain risk management into action. It supports key processes such as identifying, assessing, mitigating, and monitoring risks, which is in line with how supply chain risks management is described in earlier research (Shekarian & Mellat Parast, 2021).

The findings point to a clear link between ESG reporting and supply chain resilience. By improving transparency and visibility, ESG practices help companies recognise potential disruptions earlier and react more effectively. At the same time, measures such as supplier diversification, traceability, and long-term climate planning support preparedness

and strengthen adaptation. As Christopher and Peck (2004) suggest, resilience is built through the ability to anticipate, respond to, and recover from disruptions. The results of this study suggest that ESG reporting contributes to each of these dimensions in practice.

The study shows that the integration of ESG into supply chain risk management is not happening without challenges. Differences in supplier capabilities, data availability, and varying regulatory environments make it difficult to implement ESG practices consistently across global supply networks. As discussed in the theoretical framework, ESG integration remains fragmented across supply chain tiers (Truant et al., 2024), and this is also visible in the case companies examined in this study. While large companies have relatively advanced systems in place and reporting practices, managing ESG risks beyond direct suppliers remain challenging.

This research contributes to existing research by showing that ESG reporting should not be viewed only as a reporting requirement. Instead as a strategic and operational tool for managing supply chain risks and building resilience. The findings suggest that companies that integrate ESG into core decision making processes are better positioned to handle disruptions and maintain stable performance over time.

This study also has limitations that should be acknowledged. First, the analysis is based on secondary data, mainly company sustainability reports and publicly available disclosures. While these sources provide detailed insights into ESG practices, they reflect how companies choose to present their activities, which may not fully capture all underlying risks or challenges. As a result, the findings are dependent on the quality and transparency of the reported information. The study focuses on four large Finnish companies, which limits the generalisability of the results. These companies are relatively advanced in ESG reporting and operate in well regulated environments, meaning that the findings may not fully apply to smaller companies operating in different institutional context. The study mainly examines ESG reporting at the company level, which makes it difficult to

fully assess how practices are implemented across lower-tier suppliers. Although the case companies use tools such as supplier codes of conduct, supplier audits, and sustainability requirements to influence their supply networks, the actual implementation beyond Tier 1 suppliers remain less visible in public disclosures. Sine many supply chain risks originate deeper in the supply chain, this limits the ability to fully evaluate how effectively ESG related risk management is applied in practice.

From a practical perspective, the results highlight the importance of embedding ESG into procurement processes, supplier governance, and risk management systems. The case companies provide clear examples of how this is already implemented. UPM's use of ESG risk registers, suppliers code of conducts, and multi-tier supplier assessments shows how sustainability data can be integrated into supplier evaluation and procurement decisions. Similarly, KONE's risk-based supplier audits and corrective action processes, suppliers identified as high-risk are required to implement collective actions and undergo follow-up assessments, demonstrate how ESG requirements can be integrated in supplier governance and procurement decisions. The findings also indicate that companies benefit from using ESG data beyond reporting purposes.

Neste's application of climate scenario analysis and feedstock diversification illustrates how ESG information can support long-term planning and anticipation of disruptions. Neste conducted 36 sustainability audits in 2025, covering renewable raw material suppliers, terminals, and contractors. Neste also uses traceability systems and certification schemes such as ISCC shows how companies can improve visibility over supply chains and reduce risks related to non-compliance or unreliable sourcing. In addition, Wärtsilä's use of continuous monitoring systems and ESG metrics show real time data can improve responsiveness and operational risk management. The company tracks supplier compliance with its Code of Conduct and conducts regular assessments related to emissions, safety, and labour conditions, allowing risks to be identified early.

Based on these findings, companies should move beyond compliance driven reporting and focus actively using ESG data for decision making, scenario planning, and continuous monitoring. Furthermore, practices such as supplier diversification (Neste), multi-tier monitoring (UPM), and structured supplier audits and corrective action systems (KONE), and continuous ESG performance tracking (Wärtsilä) highlight the importance of strengthening collaboration with supplier and improving transparency across supply chain tiers to enhance resilience.

In terms of future research, several areas emerge directly from the findings of this study. The results showed that while all case companies use tools such as supplier codes of conduct, audits, and sustainability requirements, visibility decreases significantly beyond Tier 1 suppliers. For example, although companies like UPM apply multi-tier assessments and Neste uses traceability systems, the actual implementation of ESG practices deeper in the supply chain are remaining unclear. This indicates a need for more empirical research on how ESG requirements are applied across different supply chain tiers and how effective these mechanisms are in practice. The findings highlighted the increasing use of monitoring systems, traceability tools, and data driven ESG practices in companies like Wärtsilä and Neste. The results also suggest that data availability and quality remain a challenge. This points to the need for further research on how digital technologies, such as artificial intelligence and blockchain, can improve ESG data reliability, transparency, and real-time visibility across supply chains.

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