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ADOPTING SUSTAINABILITY-ORIENTED INNOVATION IN SUPPLY CHAIN TO ENHANCE SUSTAINABILITY PERFORMANCE: A CASE STUDY

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Abstract

The European Green Deal and related EU regulatory initiatives have intensified sustainability requirements for industrial firms, prompting transformative changes in supply chains toward circularity. These regulatory pressures require companies to adopt sustainability-oriented innovations (SOI) that integrate economic, environmental, and social dimensions into business and innovation processes. This paper explores how sustainability-oriented innovations are adopted at the supply chain level through an in-depth qualitative case study of a leading Baltic food manufacturing company operating globally. The study examines supply chain management practices that include implementation of sustainability-oriented innovation that supports sustainability outcomes. The results suggest how product and process SOI enables companies to create sustainable value, respond to regulatory pressures, and promote circular supply chain practices, also highlights the role of a supply chain lead firm, which orchestrates the entire supply chain, in creating SOI. By adopting a contextual supply chain approach, this paper enriches understanding of SOI in the food industry and offers managerial insights relevant to firms navigating sustainability-driven transformation under EU regulatory frameworks.

Keywords: sustainability-oriented innovations, supply chain, sustainability performance, case study

1. INTRODUCTION

The European Green Deal initiatives have driven economic, environmental, and social transformations in industrial enterprises at the supply chain level, aligning with sustainable development goals (SDGs). In response to regulatory pressures, companies must adopt effective business solutions and innovations while transitioning toward circularity (WTO, 2023). Sustainability-oriented innovations integrate economic, social, and environmental aspects as key variables in the innovation process (Feniser et al., 2017), fostering product and process development, and

contributing to sustainable value creation. Implemented at the supply chain level, these innovations align with a company's sustainability-driven strategy. However, studies (Brun & Ciccullo, 2022; Ermini et al., 2024) highlight the complexity of assessing sustainability-oriented innovations (SOI) impact on sustainability performance due to the need for stakeholder engagement, varying implementation specifics across supply chain activities, and resource reconfiguration—further confirming the relevance of such research. The scientific problem is justified by the fact that the regulatory environment requires companies to measure impacts based on sustainability performance indicators, disclose information about applied sustainability initiatives, and submit sustainability and social impact reports (e.g., ESG). However, balancing sustainability outcomes with economic and environmental priorities requires companies to adopt SOI that engage stakeholders within the entire supply chain and enhance competitiveness. While previous studies have analyzed SOI as strategic initiatives contributing to business performance (Adams et al., 2016), their development through networking and external stakeholder involvement in supply chains (Ghassim & Bogers, 2019; Inigo et al., 2020; Neutzling et al., 2018), and the application of sustainable supply chain management practices (Sharafuddin et al., 2022), the research remains fragmented, especially emphasizing empirical research and different contexts. Kumar et al. (2020) created a methodology for selecting sustainable supply chain indicators for measuring SDGs in global supply chains with a focus on the automotive industry, textile and apparel industry was analyzed by Tolentino-Zondervan & DiVito (2024). However, empirical research on other industries is lacking. Thus, scholars emphasize the need for studies that explore enhancing factors and consequences of adopting SOI in various industries (Taneja et al., 2023) and their impact on sustainability performance within supply chains.

Accordingly, to fill this gap, this article examines how food manufacturing companies are adapting and developing SOI to respond to European Green Deal initiatives and EU regulatory aspects of sustainability in the food industry supply chain. Furthermore, in this article we analyze the food manufacturing industry context, by conducting a case study of one of the most innovative and significant food manufacturers in the Baltic states Mantinga group. Mantinga group is the largest producer of frozen bread, pastries, donuts and snacks in the Baltic States, with an assortment of more than 1000 products. The company exports to 40 countries worldwide, has 4 modern factories, 3 branches in Latvia, Estonia, Ukraine and has recently been very successful in expanding into the markets of the Asian region. We conducted a detailed case study, analyzing its innovation practices and application process in the company's supply chain, in order to reveal the specifics of the activities of a company that is rapidly expanding in foreign markets, when facing sustainability challenges, such as climate change, social and economic aspects, and indicating how the food manufacturing company responds to regulatory environment by applying sustainability oriented innovations. This leads to the following research question how are sustainability-oriented innovations adopted in the food supply chain and how do they relate to sustainability performance?

This article aims to explore the practices of adopting SOI in a leading Lithuanian food manufacturing company's supply chain to enhance sustainability performance.

This study contributes to literature in two main ways. First, it provides an empirical, supply chain-level analysis of SOI in the food manufacturing industry, which remains underexplored compared to other sectors. Second, it extends existing research by demonstrating how a focal firm orchestrates the implementation of SOI across supply chain actors under regulatory pressure.

Empirically, the study offers in-depth insights into how SOI practices are implemented and linked to sustainability performance indicators in a real-world case.

2. THEORETICAL BACKGROUND

2.1. Sustainability-oriented innovations and their clasification

Sustainability-oriented innovations (SOI) are complex, deliberate, and strategic corporate decisions aimed at creating economic value while simultaneously reducing negative environmental impacts and strengthening social well-being. Such innovations emerge as responses to global challenges, including climate change, depletion of natural resources, social inequality, and economic instability (Hermundsdottir & Aspelund, 2022) and The main objective of adopting SOI is to balance the three core dimensions of sustainability (Sharifpour Arabi et al., 2025): 1) environmental – minimizing adverse environmental impacts through more efficient use of natural resources, reductions in greenhouse gas emissions, increased reliance on renewable energy sources, and the protection of ecosystems and biodiversity; 2) social – ensuring fair working conditions, strengthening social inclusion, enhancing community well-being, and increasing transparency, accountability and responsibility across supply chains; 3) economic - enhancing business competitiveness, improving resource efficiency, lowering operational costs, encouraging the adoption of innovations, and enabling sustained long-term economic performance. This tripartite sustainability logic also underpins the green supply chain as a new business model, where redesigning processes and cooperation rules serves both customer satisfaction and environmental objectives simultaneously (Tundys, 2020).

SOI can be classified according to several key criteria related to their scope of application, underlying characteristics, and expected impact. The classification framework proposed by Klewitz & Hansen (2014) facilitates a structured way to understand the diversity of SOI, their functional roles, and their potential implications on business performance, society, and the environment. Each type of SOI contributes to advancing more sustainable and responsible business practices by reducing environmental pressures, strengthening social responsibility, and supporting economic efficiency.

SOI are commonly divided into 1) product innovations and 2) process or organizational innovations. Although process and organizational innovations are sometimes treated as separate categories, they are frequently conceptualized within a broader organizational perspective. Accordingly, in this study, they are grouped into a single category. The following sections provide a detailed examination of each SOI type. Given the specific characteristics of the food industry, product SOI and their implementation play a particularly important role and are therefore emphasized.

Product SOI in the food industry include the development of new or improved food products that contribute to sustainability by enhancing nutritional value, reducing environmental impacts, or improving consumer health. Within the food supply chain, such innovations can occur across all stages, ranging from raw material production and processing to packaging and consumption. Accordingly, two main categories of product SOI can be distinguished: 1) raw material and ingredient innovations, and 2) packaging innovations.

One of the key objectives of product SOI is to reduce environmental impacts, which can be achieved by modifying the composition of food products. One important approach involves the use of alternative protein sources. Livestock production is a major contributor to greenhouse gas emissions, accounting for a substantial share of global anthropogenic emissions, particularly methane released through animal-based food systems (Ning et al., 2024). In response to this challenge, increasing attention is being given to sustainable protein sources, such as plant-based proteins (e.g., peas, beans, soy), which are used as meat analogues or dairy substitutes; insect-based proteins (e.g., from crickets), which offer high nutritional value with a relatively low environmental footprint; and microbial proteins, also referred to as single-cell proteins, derived from rapidly growing microorganisms such as fungi (*Beyond Meat*, n.d.; *Divaks*, n.d.; *Nature's Fynd*, n.d.). These innovations help reduce reliance on animal-based products, lower water and land use, and decrease CO_2 emissions. To further reduce transportation distances and dependence on global supply networks, companies increasingly prioritize the use of locally sourced raw materials, which also

contributes to lower emission levels (Chi Ffoleau & Dourian, 2020). In line with sustainability principles, product SOI also focus on the development of healthier alternatives, including the replacement of sugar with sweeteners (e.g., stevia, polyols), the use of salt substitutes (e.g., potassium chloride) to reduce sodium intake, and the growing application of functional ingredients such as prebiotics, probiotics, and vitamins (Asioli et al., 2017). Sustainability principles are also reflected in the "clean label" concept, which refers to products made with a small number of natural and easily recognizable ingredients, without artificial additives, and with clear information about their composition and origin. Because these products are usually based on natural, locally sourced, and minimally processed raw materials, they often have a lower carbon footprint, contributing to environmental sustainability. Notably, consumers are not merely recipients of these innovations as their environmental awareness and end-of-life product behavior are recognized as active determinants of green supply chain outcomes (Tundys, 2020). From a social perspective, clean-label products support more informed consumer choices, allowing consumers to choose healthier and more ethically produced options. Economically, this approach helps create higher value-added products and appears to improve transparency within raw material supply chains (Asioli et al., 2017).

The selection of supply chain actors – particularly raw material suppliers – in food industry companies is increasingly based on certification schemes that ensure the sustainable and ethical origin of raw materials. Commonly used certifications include *EU Organic / USDA Organic*, which confirm that raw materials are produced without synthetic pesticides or GMOs and in accordance with organic farming practices; *Fairtrade*, which guarantees fair remuneration for producers and ethical working conditions; and *Rainforest Alliance*, applied to raw materials such as cocoa, coffee, tea, and palm oil, ensuring both environmental and social responsibility (*All Ecolabels on Food | Ecolabel Index*, n.d.). These certifications are typically displayed on product packaging, often accompanied by QR codes or NFC tags, enabling consumers to access and verify sustainability-related information in real time.

The role of packaging in the food industry supply chain is highly significant, as it not only protects the product and ensures its shelf life, but also serves as a key source of information for consumers. Traditional packaging solutions that rely heavily on plastic are convenient, cost-efficient, and effective in protecting products from moisture and unwanted microorganisms. However, they also generate substantial environmental impacts, which has increased the urgency of adopting more sustainable packaging solutions. Packaging innovations contribute not only to the development of the circular economy but also support greater supply chain transparency and compliance with regulatory requirements (Donkor et al., 2023). Packaging innovations are typically not developed directly by food manufacturing companies themselves, rather, they originate from specialized technology and material developers and are subsequently adapted by food industry actors to their specific needs. One of the most widely adopted innovative pathways is the transition from fossil-based plastics to biodegradable, compostable, or recycled materials. The development of materials such as polylactic acid (PLA), polyhydroxyalkanoates (PHA), and polybutylene succinate (PBS) suggests that packaging can be produced from renewable sources, including corn starch, sugarcane, or agricultural residues. In addition, emerging materials such as algae-based materials and mycelium are explored due to their improved biodegradability and overall sustainability performance (Donkor et al., 2023). Food industry companies also invest in systems that ensure biodegradable plastics can be properly composted or recycled at the end of their life cycle. Such integration aligns with broader environmental objectives and promotes a more sustainable approach to material use. Furthermore, the development of advanced packaging solutions incorporating digital technologies – such as QR codes, NFC and RFID tags – enables consumers to trace a product's journey along the supply chain. These technologies provide real-time information on product origin, production conditions, certification, and environmental impacts, thereby enhancing transparency at the point of sale and responding to growing consumer demand for ethically and sustainably produced food products. For example, when recycled materials are used, QR codes can be employed to disclose information about material origin, recycling processes, or the proportion of recycled content in the final product

(Meyers, n.d.). Such solutions strengthen transparency, raise consumer awareness, and support companies' ESG commitments. In addition, the food industry increasingly applies functional packaging solutions. Antimicrobial packaging, for instance, incorporates agents such as silver ions, essential oils, or enzymes to inhibit microbial growth, thereby extending product shelf life – an especially relevant solution for highly perishable products. Reactive or indicator packaging may also be used, responding to external factors such as temperature fluctuations, shelf-life progression, or microbiological contamination. When such changes are detected, the packaging alters its color or structure, warning consumers about potential food safety issues. Common examples include freshness indicators and time–temperature indicators (Donkor et al., 2023). These innovations facilitate supply chain monitoring, enhance consumer protection, and contribute to the reduction of food waste.

Process or organizational SOI are closely related to the food industry supply chain itself and focus on improving production, logistics, and other business processes to reduce energy and raw material consumption, waste generation, and pollution. These innovations are often technological in nature, while simultaneously addressing firms' environmental, economic, and social objectives (Cheng et al., 2023). The food industry supply chain covers the entire pathway from primary raw materials to the final consumer and involves numerous interrelated processes. As a result, each stage of the chain can become a potential site for process innovation aimed at increasing efficiency, sustainability, and value creation. The application of *lean* practices to optimize operations (Jum'a et al., 2022) and the adoption of *Industry 4.0* (I4.0) technologies contribute to the development of the circular economy. Technologies such as *blockchain* and the *Internet of Things* (IoT) enhance product traceability and appears to improve process management, while *big data* analytics, artificial intelligence, and automated monitoring systems help reduce energy consumption and waste generation across the supply chain (Quiroz-Flores et al., 2024). The implementation of circular economy principles is particularly important in the food industry – for example, secondary raw materials and food production by-products can be converted into new products, such as dietary fibres, animal feed, or protein ingredients. In addition, biodegradable and reusable packaging can be returned, composted, or reused, thereby reducing waste volumes. In the dairy industry, anaerobic digestion is applied to transform bio-waste into biomethane, which can be used for energy generation or heating purposes (Hamam et al., 2021). Water use efficiency represents another key area of innovation in the food industry. The industry is characterized by high water demand, particularly in meat, dairy, and fruit and vegetable processing. Approximately 70% of water consumption is related to equipment cleaning and maintenance operations. Process innovations such as water recirculation systems, *clean-in-place* (CIP) technologies, and membrane filtration systems (e.g., reverse osmosis) enable substantial reductions in water use while simultaneously decreasing wastewater generation (IChemE, n.d.).

Other organizational innovations, including the adoption of new management practices, business models, or forms of collaboration that promote sustainability, are also widely applied in food industry companies. These innovations focus on changes in organizational structures, processes, and corporate culture, enabling a more effective integration of sustainability principles into everyday operations (Van Oppen & Brugman, n.d.). Employee occupational safety, health, and inclusion constitute an integral part of organizational sustainability. Working conditions in the food industry can be physically demanding and challenging, often involving humid environments, temperature extremes, intensive manual labor, and the handling of hazardous materials. Therefore, ensuring safe workplaces, maintaining high occupational health standards, and fostering employee awareness and motivation are critical elements of sustainable organizational practices in the food industry (Lee & Ha-Brookshire, 2018).

Integrated quality management systems and certification are a prerequisite for compliance with the regulatory framework governing food industry companies in the EU. One of the most widely applied systems in the food industry is ISO 22000, an international standard that integrates *HACCP* (Hazard Analysis and Critical Control Points) principles with general food safety requirements. ISO

22000 enables companies to systematically identify, assess, and control potential food safety risks while ensuring continuous process improvement (Luning & Marcelis, 2020). In addition, *Good Manufacturing Practice* (GMP) represents a fundamental set of requirements underpinning food safety management. GMP ensures that food is produced, processed, and stored in accordance with hygiene, technological, and personnel management standards (Luning & Marcelis, 2020). From a sustainability perspective, GMP contributes to the reduction of production defects and food waste, lowers the risk of operational errors, and supports more efficient use of resources. For export-oriented companies that must comply not only with national and EU regulations but also with international standards and the quality and safety requirements of major retail chains, the FSSC 22000 food safety management system is often additionally implemented. FSSC 22000 is based on ISO 22000 but includes a set of mandatory additional requirements tailored to industrial food production. These requirements cover specific measures related to hygiene, sanitation, infrastructure, personnel management, and process control. A key feature of FSSC 22000 is its compliance with the recognition criteria of the *Global Food Safety Initiative* (GFSI), which ensures wide acceptance throughout the international food supply chain. Beyond guaranteeing a high level of food safety, FSSC 22000 helps reduce supply chain risks, enhances customer trust, and facilitates access to export markets (Karaman et al., 2012).

When discussing food safety management systems, it is also important to consider another essential dimension of sustainability – certification schemes that ensure product and ingredient quality, safety, and transparency of origin. In the contemporary food industry, recognized certifications enable companies to export their products and participate in global supply chains. One such certification is the *BRCGS* (British Retail Consortium Global Standard), which ensures food safety, product quality, and legal compliance. Without this standard, access to markets such as the United Kingdom, Ireland, Canada, and other Western European countries is effectively restricted (Safe Food Alliance, n.d.). Another important example is the *IFS* (International Featured Standards) certification, which plays a critical role in supplier assessment and is a mandatory requirement for cooperation with major retailers in markets such as Germany, France, and Italy (International Featured Standards, n.d.).

2.2. Implementation of SOI in the supply chain and sustainability performance indicators

To assess the implementation of SOI within the food industry supply chain, it is necessary to analyze environmental, social, and economic indicators, which can be measured quantitatively through key performance indicators (KPIs). These indicators enable the monitoring of progress in innovation implementation, the assessment of operational impacts, and the identification of future innovation directions. This multi-stage assessment logic corresponds to upstream-midstream-downstream performance measurement frameworks proposed in green supply chain literature, where each stage requires distinct measurement criteria (Tundys, 2020).

The table below provides an overview of key sustainability factors, industry-specific indicators, implementation stages within the food supply chain, and corresponding expressions of indicators. The table serves as a conceptual framework illustrating how SOI can be operationalized and monitored across environmental, social, and economic dimensions in the food industry. While these indicators are not empirically tested in this study, they offer a structured reference for interpreting sustainability practices discussed in qualitative analysis and for guiding future quantitative research.

Table 1 Adaptation of SOI and specific indicators in the food industry supply chain

Sustainability factors	Specific indicators in food industry	Implementation in supply chain	Performance indicators in food industry
Environmental			
Carbon footprint	Reduction of GHG emissions, renewable energy	Sourcing of raw material; Production; Logistics	CO_2 kg per product, percentage of renewable energy in total energy consumption
Water footprint	Recycling, efficient irrigation solutions	Production; Recycling	m^3 of water per product
Reduction of agrochemical use	Organic farming, biological fertilizers	Primary production	Percentage of organic raw materials
Energy efficiency	Process optimization and automation	Production; Warehousing; Logistics	kWh per product
Food waste	By-product recycling	Production; Distribution; Retail	Percentage reduction in waste, percentage of recycled by-products
Sustainable packaging	Use of compostable and recyclable materials	Packaging	Percentage of sustainable packaging
Social			
Responsible sourcing	Partnerships with small and medium-sized farms, certified suppliers	Sourcing of raw material; Production	Percentage of certified suppliers
Safe and healthy working conditions	Compliance with occupational health and safety standards (ISO 45001, HACCP), physical and psychological well-being programs, regular health screenings	Sourcing; Production	Number of workplace accidents per year, employee satisfaction index
Employee skills development	Food safety training, sustainability training, development of digital competencies	Sourcing; Production; Distribution and Logistics; Retailing; Reverse Logistics	Average number of training hours per employee per year, percentage of employees who participated in professional development programs per year
Fair Labour	Transparent working conditions, fair compensation for overtime, discrimination prevention	Sourcing; Production; Distribution and Logistics	Average hourly wage, employee survey results
Diversity & Inclusion	Inclusion of women across all hierarchical levels, diversity in leadership, equal opportunities	Sourcing; Production; Distribution and Logistics; Retailing; Reverse Logistics	Share of women in managerial positions (%), gender pay gap index
Economics			
Product life cycle optimization	Reduction of food waste, extension of shelf life, recycling	Production, Logistics; Retail	Food waste quantity (kg/unit), average shelf life, share of recyclable components (%)
Monitoring operational performance and KPIs	Integration of sustainability KPIs into reports, monitoring economic and ESG indicators	Sourcing; Production; Distribution and Logistics; Retailing; Reverse Logistics	Percentage of sustainability KPIs integrated into overall performance reports, percentage of decisions based on ESG analysis
Investments in innovation	Funds allocated to the development of SOI	Production; Logistics	Percentage of total investments allocated to SOI, innovation ROI
Attraction of investments	Secured sustainable investments and participation in green project financing	Sourcing; Production; Distribution and Logistics; Retailing; Reverse Logistics	Number of sustainable investments, ESG rating position, number of funded support projects
Positive customer experience	Product quality and food safety, transparent labeling and sustainability information, fair pricing	Logistics; Distribution; Retailing	Customer Satisfaction Index (CSI), Net Promoter Score (NPS), repeat purchase rate (%), Customer complaint rate

Source: based on the general sustainability factors proposed by Tolentino-Zondervan & DiVito, 2024)

Sustainability KPIs in the food supply chain include environmental, social, and economic dimensions that are closely interrelated and mutually reinforcing. Each stage of the supply chain can be assessed using specific indicators that reveal progress in sustainability performance or highlight existing shortcomings. Appropriately selected and effectively implemented indicators not only enable an objective evaluation of company performance, but also support better decision-making, the development of ESG strategies, and the strengthening of stakeholder trust.

3. METHODOLOGY

3.1. Research setting and case selection

A case study approach was chosen as it is well-suited for exploring emerging phenomena, capturing contextual dynamics, and integrating complex data (Baxter & Jack, 2015; Eisenhardt, 1989; Yin, 1984). Case studies are particularly effective for exploring contemporary phenomena within real-life settings, allowing for rich, holistic analysis (Flick, 2015).

Triangulation was achieved through a combination of primary data (semi-structured interviews) and secondary sources (e.g., company reports and policy documents), enhancing the validity and reliability of findings (Eisenhardt, 1989; Hair et al., 2007). Triangulation supports the convergence of evidence and strengthens research findings (Meydan & Akkaş, 2024).

3.1.1. Research setting

This study is set within the food manufacturing industry, an industry which is one of the most economically significant sectors in the EU, combining strategic importance for food supply with a strong contribution to economic growth. The industry generates substantial value added, employment opportunities, and export revenues, making it a key driver of industrial activity across the EU. Recent industry data indicate that the food and beverage industry is the largest manufacturing industry in the EU, producing around €1.2 trillion in turnover and over €250 billion in value added in 2024. With more than 4.7 million employees, it also remains the leading source of employment within EU manufacturing (*FoodDrinkEurope*, 2025).

From a regional perspective, the food industry plays a particularly important role in labor markets across several Member States. In Southern and Eastern Europe, food manufacturing accounts for a significant proportion of industrial employment, reaching approximately 14-16 % in countries such as Spain and Italy, and close to 18 % in Poland (Eurostat, 2024). Given its scale, changes in production structures, technologies, or innovation practices within the food industry can have direct economic and social consequences.

The industry also holds a strong position in international trade. In 2024, EU exports of food and beverages exceeded €235 billion, while imports amounted to roughly €170 billion, resulting in a clearly positive trade balance (European Commission, 2025). The competitiveness of EU food products increasingly depends not only on quality and price, but also on compliance with strict standards related to food safety, traceability, and sustainability, which strengthen the industry's position in global markets.

At the same time, this industry is one of the most environmentally impactful manufacturing sectors in the European Union. Its production processes are characterized by high energy, water, and raw material intensity, resulting in a significant contribution to greenhouse gas emissions. According to FoodDrinkEurope (2025), the food, beverage, and tobacco industry accounts for approximately 11.5% of total industrial energy consumption in the EU, with energy-intensive processes such as cooling, heating, drying, and transportation being essential for food production processes. The

environmental impact of the food industry extends beyond energy use. In 2021, the EU food industry generated approximately 85 million tonnes of CO_2 emissions. While part of these emissions originates in primary agricultural production, food processing remains a major contributor due to its reliance on energy-intensive operations and rather complex supply chains (FoodDrinkEurope, 2024). Such challenges have intensified the need for SOI, particularly in areas such as energy efficiency, waste reduction, sustainable packaging, and supply chain optimization.

SOI in the European Union is not only promoted but also continuously monitored. One example is the Eco-Innovation Index (EII) developed by the European Commission, which provides a structured overview of countries' eco-innovation performance across several dimensions. Although the index operates at the national level, it signals that SOI outcomes are regularly measured and compared at the policy level, shaping the context in which food manufacturing firms develop their innovation activities.

Between 2014 and 2024, the overall EU EII increased by 27.5%, mainly due to improvements in resource efficiency and growth in sustainability-related research outputs. Within this broader EU trend, Lithuania achieved the largest growth among all Member States, supported by increases in eco-innovation publications, water productivity, and ISO 14001 certifications (*Eco-Innovation Index in Europe | Indicators | European Environment Agency (EEA)*, n.d.). This national progress provides a relevant background for selecting a Lithuanian food manufacturing company, which is a leader in Baltic States, as the case in this qualitative study.

3.1.2. Rationales for case selection

The case company selected for this study is Mantinga Group, the largest producer of bakery products, snacks, and frozen food products in the Baltic States, operating since 1998. The company operates as an international food manufacturing group, integrating production, logistics, and commercial activities across several organizational units, including Mantinga Production, Mantinga Bakery & Food Solutions, Mantinga Services, and Mantinga Logistics.

The group operates four manufacturing facilities, with a total production area exceeding 50,000 m^2, reflecting a high level of operational scale and organizational complexity. In 2024, the company implemented a new group structure, with Mantinga Group acting as the holding company coordinating manufacturing, logistics, and strategic development activities. The Group employs approximately 1,700 people, produces nearly 60,000 tonnes of products annually, and generates annual turnover of around €190 million.

The company is strongly export-oriented, supplying products to over 40 international markets, including Western and Northern Europe, as well as selected global markets outside the EU, such as USA, UAE, Japan, South Korea. It has 4 modern factories, 3 branches in Latvia, Estonia, Ukraine. This global presence requires compliance with diverse food safety, sustainability, and regulatory standards, making the company particularly relevant for research in the field of international business and SOI.

3.2. Data collection

The informants were selected based on their roles and direct involvement in sustainability-related decisions across different areas of the company's operations: an R&D technologist responsible for product development and innovation, the Head of the Product Development Department, a Sustainability and Packaging Project Manager, and the Chief Executive Officer (CEO). The data in the table indicates a summary of the participants in the study.

The interviews were semi-structured and based on a predefined interview guide. The guide included key themes such as SOI implementation, motivations, constraints, governance mechanisms, and sustainability performance assessment. Each interview lasted approximately 60 minutes.

The limitation of this study is related to the composition of the interview sample. Although informants were selected based on their involvement in sustainability and innovation processes, three out of four participants represent Marketing and Communication-related functions. Perspectives from other key functional areas, such as operations, procurement, or finance, are not directly captured. This may limit the comprehensiveness of insights regarding operational and financial dimensions of SOI implementation.

Table 2 Profiles of the interview data

No.	Informant's department	Informant's organizational level	Position and responsibility	Gender
A	Marketing and Communications	Operational	R&D technologist (New Product Development)	Male
B	Executive Management	Strategic	Group CEO	Male
C	Marketing and Communications	Operational	Head of the Product Development Department	Female
D	Marketing and Communications	Operational	Sustainability & Packaging Project Manager	Female

Secondary data analysis was conducted in the study to systematize existing information on SOI in the food industry and to identify the key factors influencing the implementation of such innovations within the supply chain. The analysis was based on document content analysis, which enabled a broader contextual understanding and allowed the company's actions to be compared with prevailing industry trends. The secondary data and document analysis included publicly available documents related both to the case company (including archival internal company documents) and to the regulatory environment and industry requirements relevant to the food industry.

Table 3 Profiles of the secondary and company's archival data

No.	Content	Data source
Internal documents		
1	Mantinga Group Sustainability Strategy 2023	Mantinga official website
2	Mantinga Group Sustainability Report 2024	
3	Mantinga Group Anti-corruption Policy	
4	Mantinga Group Code of Ethics	
5	Mantinga Group Equal Opportunity Policy	
6	Mantinga Group Supplier Code of Ethics	
External documents		
1	EU Green Deal	European Commision official website
2	Lithuanian Climate Change Management Agenda (2021–2050)	Official website of the Government of the Republic of Lithuania
3	EU "Fit for 55"	European Commision official website
4	EU "Farm to Fork" Strategy	European Commision official website
5	UN SDG 12.3 (2015–2030)	UN official website
6	EU Circular Economy Action Plan (2015–2050)	European Commision official website

7	Lithuanian Waste Prevention and Management Plan (2021–2027)	Official website of the Government of the Republic of Lithuania
8	EU CSRD Directive	European Commision official website
9	Lithuanian Sustainable Development Strategy (2009–2030)	Official website of the Government of the Republic of Lithuania

Thematic theoretical analysis was used to analyse the data, enabling identification and interpretation of patterns and themes relevant to the research questions, we elaborated on SOI constraints (product and process), SOI motivation and implementation, governance and regulations, stakeholders, impact assessment and outcomes. This approach supports understanding and theory development from qualitative data (Flick, 2015).

3.3. Data analysis

The interviews were conducted between July and August 2025. Each interview lasted about 60 minutes and was audio-recorded with participants' consent. All recordings were subsequently transcribed and coded. To ensure the reliability of the research, a comprehensive database was created, containing interview transcripts, secondary data, and other relevant documents. The transcripts and field notes were analyzed using categories derived from the theoretical framework discussed earlier.

For data analysis, the MAXQDA software was employed due to its robust capabilities for processing and analyzing qualitative interview data. The data and transcriptions were reviewed, coding was carried out according to pre-defined categories, codes and subcodes were formulated, and then interpreted according to the research objectives. A total of 8 codes and 32 subcodes were applied. The coding system was developed using 117 citations, of which 34 were associated with Informant A, 32 with Informant C, 26 with Informant B, and 25 with Informant D.

The data analysis followed a thematic analysis approach. Initially, predefined categories were derived from the theoretical framework. Subsequently, open coding was applied to identify emerging themes. Codes and subcodes were iteratively refined during the analysis process. To ensure reliability, the coding process involved repeated review of transcripts and consistency checks between codes and theoretical constructs. Triangulation was implemented by systematically comparing interview data with secondary sources, including company ESG reports, sustainability strategies, and policy documents. Interview data provided insights into internal practices, while secondary data enabled validation of sustainability outcomes and alignment with regulatory targets.

4. FINDINGS

4.1. Secondary data findings

External documents. The EU and the Republic of Lithuania are committed to ambitious sustainability objectives defined through policy frameworks, including the European Green Deal, the EU Climate Neutrality Strategy for 2050, the "Farm to Fork" Strategy, and national climate change and waste management programmes. These documents establish quantitative targets, ranging from greenhouse gas emission reductions by 2030 to climate neutrality by 2050, as well as goals related to food waste reduction and packaging recycling. In its sustainability strategy and reporting, Mantinga Group sets out specific KPIs that can be compared with these EU and national targets, enabling an assessment of how the company aligns with and responds to the established regulatory and policy requirements.

Table 4 Comparison of compliance with EU and national sustainability policies and regulations

Policy / regulation	Defined target	Case company	Compliance assessment
EU Green Deal / Lithuanian Climate Change Management Agenda (2021–2050)	Achieve climate neutrality by 2050	6,670 tonnes of CO_2 emissions in 2024	The company is systematically implementing emission reduction measures, however, accelerated actions are required to align with targets
EU "Fit for 55"	Reduce EU greenhouse gas emissions by 55% by 2030 compared to 1990 levels	The company's GHG emission intensity (market-based method) decreased by 12.9% between 2018 and 2024	Progress has been made; however, faster reductions are required
EU "Farm to Fork" Strategy / UN SDG 12.3 (2015–2030)	Reduce food waste by 50% by 2030	Non-standard but safe-to-consume products are redistributed through charitable channels or alternative sales outlets; biodegradable food waste is directed to biogas production	Measures to address the objective are in place, systematic measurement and monitoring are lacking.
EU Circular Economy Action Plan (2015–2050)	Promote circularity, recycling, and product longevity across supply chains	87% of packaging is recyclable; production waste reduced by 12% through the application of *Lean*	Initiatives are actively implemented and align with circular economy objectives
Lithuanian Waste Prevention and Management Plan (2021–2027)	Increase the share of waste prepared for reuse and recycling to 57% by 2027, compared to 2018 levels	In 2024, 91.42% of waste is recycled	The target has been achieved and exceeded
EU CSRD Directive	Require large companies to prepare and disclose ESG reports starting from 2023	ESG report is prepared and published annually	Objective achieved / ongoing compliance
Lithuanian Sustainable Development Strategy (2009–2030)	Implement sustainable development goals at the national level	Sustainability objectives and related measures are outlined in the company's ESG report	The strategy is integrated, actions are aligned with sustainable development goals

Internal documents. The analysis of internal documents was conducted to examine how sustainability principles and SOI are embedded within the governance and operational framework of Mantinga Group. The analysed materials include a range of strategic, regulatory, and operational documents, such as internal policies, codes, and guidelines that shape the company's approach to sustainability, ethics, social responsibility, and risk management. Together, these documents define

organizational values, ESG priorities, standards of employee and supplier conduct, and principles of responsible business practices. The analysis provides insight into the company's formal sustainability commitments, defined objectives, and implemented measures, and enables an assessment of how sustainability considerations are integrated into internal processes and managerial decision-making. The table below outlines the main internal documents of Mantinga Group that guide the company's governance and support the implementation of sustainability, ethical conduct, and social responsibility standards.

Table 5 Overview of internal policies of Mantinga Group

Document	Purpose	Key principles
Anti-Corruption Policy	Defines Mantinga Group's zero-tolerance position towards corruption; applicable to all group companies, employees, and third parties	Strict prohibition of bribery, conflicts of interest, and improper gifts Example set by leaders and mandatory employee training Encouragement of anonymous reporting of violations with guaranteed reporting individual protection
Sustainability Policy	A policy integrated into the group strategy and applicable across all business units; establishes ESG objectives	Climate neutrality by 2050 (Scope I–III emissions) Responsible sourcing of certified raw materials Packaging optimization and waste reduction Principles of circular economy, energy efficiency, employee well-being, and community support Policy reviews every two years
Code of Ethics	Defines standards of conduct for employees and business partners, including human rights, working conditions, business ethics, confidentiality, and food safety	Core values: creativity, flexibility, responsibility Zero tolerance for discrimination and harassment; respect for working time and fair remuneration Strict rules on gifts, competition, and corruption prevention Compliance with ISO 14001, IFS, BRCGS, and HACCP requirements in production
Equal Opportunities Policy	Establishes principles ensuring equal opportunities for all employees and candidates throughout recruitment, employment, and career development	Prohibition of discrimination based on gender, age, race, religion, sexual orientation, or disability Safe and ergonomic working environment; psychological well-being programs Employee involvement in decision-making and continuous training in sustainability and equal opportunity principles
Supplier Code of Conduct	Applies to all direct and indirect suppliers and requires compliance with UN, ILO, and CITES principles	Mandatory compliance with legal requirements and ISO 14001; appointment of a social responsibility representative at supplier level Prohibition of forced and child labor, requirement for safe working conditions Waste sorting, wastewater management, and energy and water efficiency Prohibition of GMOs and hazardous chemical substances

4.2. Primary data

In the Mantinga group, SOI are understood in a holistic way – covering environmental, social, and economic objectives – and are implemented through product development, raw material selection, packaging solutions, process efficiency improvements, employee engagement, governance practices, and impact assessment. At the same time, several key constraints were identified, including higher financial costs, technological barriers, and challenges related to maintaining

product quality. Interview findings indicate that product SOI are primarily driven by consumer needs, market trends, and customer requirements. Product SOI focuses on recipe reformulation, plant-based product development, and the use of innovative, certified, and locally sourced raw materials to reduce environmental impact while maintaining product quality.

Table 6 Product SOI in case company

Code	Subcode	Illustrative quotes
Product SOI	Clean-label reformulation	"We work with recipes to reduce sugar and salt content, and to increase fibre and protein levels" (Informant B). "Consumers want to easily understand product composition, without E-numbers, therefore for several years we have been working towards reducing or eliminating additives as much as possible" (Informant C)
	Plant-based / vegetarian / vegan products	"This is done to respond to sustainability as well as vegetarian and vegan dietary needs" (Informant A) "The greatest demand comes from foreign customers, who increasingly choose plant-based and vegan products" (Informant C)
	Low-carbon and innovative raw materials	"We search for alternative raw materials that would have a lower CO_2 impact" (Informant C). "We use various plant-based proteins in production" (Informant A)
	Certified raw materials	"For example, certified cocoa and palm oil, 'happy hens' eggs" (Informant D)
	Integration of local raw materials	"We are looking for opportunities to source raw materials from local farms and nearby producers" (Informant C)

Overall, the company has implemented at least 6 product-related SOIs, reflecting a strategic response to sustainability-oriented consumer demand and customer expectations across domestic and international markets. Process SOI are embedded in daily operations and focus on efficiency, resource optimization, and digitalization. These innovations are closely linked to lean management practices, energy efficiency measures, packaging optimization, and automated production processes.

Table 7 Process SOI in case company

Code	Subcode	Illustrative quotes
Process SOI	Lean methods and continuous improvement	"We apply hoshin kanri principles to cascade objectives throughout the organisation" (Informant B). "Lean methodology is applied mainly in production processes, focusing on waste reduction and efficiency improvements" (Informant C).
	Energy efficiency and optimisation	"Waste heat is reused for space heating and technological processes" (Informant B). "Green electricity is used (99%)" (Informant D).
	Waste reduction and valorisation	"Dough scraps generated during production are returned to the beginning of the process and reused" (Informant A). "Other food waste is converted into biofuel" (Informant A).
	Packaging optimisation	"We use the thinnest possible films that still ensure product safety during transport" (Informant A). "Packaging size is reduced and packaging is thinned to minimise plastic use" (Informant C).
	Use of recyclable packaging	"We try to choose plastics that are recyclable" (Informant A). "Recycled and recyclable packaging is used" (Informant D).
	Digitalisation and automation	"All technological and production information is presented in digitalised form" (Informant A). "Most of the equipment used in production is automatically controlled" (Informant D).

At least 10 sustainable process innovation directions are empirically identified. Circular economic principles are reflected in initiatives aimed at reducing waste and maximizing resource efficiency, particularly through the internal reuse and valorisation of production by-products. The findings suggest that process SOI are more operationally mature than product SOI, supported by systematic management tools, digital technologies, and continuous improvement systems.

According to the results, the majority of SOI are applied in the following supply chain activities: production, packaging, raw material sourcing, and logistics. At the production stage, technological and process innovations are implemented, such as heat recovery systems, optimisation of energy and water consumption, and waste reduction. Biodegradable waste is directed to biogas production, while dough scraps generated during forming processes are returned to production. In packaging solutions, recyclable materials are used, plastic content is reduced, and digital solutions are applied to ensure transparency and traceability. In the sourcing stage, the company transitions towards certified raw materials and sets clear environmental and social requirements for suppliers, thereby embedding sustainability principles throughout the value chain. In logistics, energy-efficient transport solutions are introduced, routes are optimised, and IT systems are implemented to improve order management efficiency.

Despite extensive SOI activity, several challenges constrain the implementation and scaling of SOI globally, particularly in a large-scale food production context.

Table 8 SOI implementation challenges in case company

Code	Subcode	Illustrative quotes
SOI implementation challenges	Financial costs	"Sustainable ingredients or technologies are usually more expensive" (Informant B). "Such a product becomes 20–30% more expensive to produce" (Informant C).
	Technological barriers	"Compostable packaging is not used because it is unsuitable for freezing" (Informant A). "There is no appropriate infrastructure at the national level" (Informant D).
	Risk to product quality	"If it has a negative impact on final product quality, then it is better not to implement it" (Informant C).

These challenges highlight trade-offs between sustainability ambitions, technological feasibility, and economic viability, particularly when product quality is prioritized.

Beyond challenges, the adoption of SOI is supported by a combination of strategic, market-driven, regulatory, and economic motivations by board of directors and management, as well as all stakeholders. These motivations reflect both long-term organisational values and short-term efficiency considerations.

Table 9 SOI implementing motivations in case company

Code	Subcode	Illustrative quotes
Motivation	Strategic motivation	"Sustainability has become an inseparable part of the company" (Informant C).
	Market-driven motivation	"First of all – consumer needs and dietary trends" (Informant B).

	Regulatory motivation	"EU and national requirements are a foundation, not a barrier – they stimulate innovation" (Informant D).
	Economic motivation	"If we use less electricity or gas to produce the same output, unit costs decrease and profitability increases" (Informant B).

Taken together, the results indicate that SOI implementation is not driven by a single factor, but rather by an interplay of internal strategic orientation and external market and regulatory forces. Importantly, efficiency gains and cost reductions play a critical role in legitimising sustainability initiatives within the organisation.

Table 10 Governance and regulations

Code	Subcode	Illustrative quotes
Governance and regulations	Integrating sustainability into company strategy	"Sustainability is an important part of the company, as it is reflected in many aspects. One of the company's values is "responsibly", which essentially encompasses sustainability" (Informant A); "Sustainability is structurally integrated into all organizational activities" (Informant D); "Intensive work is being done on the sustainability strategy in order to meet the goals and implement the planned indicators" (Informant C).
	Regulatory requirements	"Sustainability indicators are often a prerequisite for getting on the procurement lists of large chains, without them they simply do not consider the company" (Informant B); "Sustainability is essential for the development of TI, on the other hand, it is a limiting factor for the company, because sustainability is a challenge that often stops or slows down processes" (Informant A); "Both EU and national requirements are the basis, not a barrier, – they encourage changes and innovations in operations" (Informant D).
	Compliance with standards and certificates	"We have a Supplier Code of Ethics and basic food safety certificates (e.g., IFS/BRC)" (Informant B); "We comply with BRC, IFS, ISO and other international standards, apply the principles of responsible production, the certificates cover food safety, quality, and environmental protection" (Informant D); "If we don't have standards, if we don't follow them, our products won't make it to store shelves" (Informant C).
	Requirements for suppliers	"The requirements apply not only to us, but also to our suppliers' suppliers, so that the entire supply chain is more sustainable" (Informant B); "Our suppliers, such as RSPO, also need to have appropriate certificates" (Informant A); "Mantinga group carries out ESG assessment of suppliers, assesses suppliers' environmental and social responsibility, selects suppliers according to quality, origin, transparency criteria. These criteria are applied as part of supply chain control and sustainability integration" (Informant D).

Accordingly, stakeholder involvement plays an important role in shaping sustainable supply practices in food manufacturer leading supply chain, acting both as a compliance requirement and as a driver of SOI.

Table 11 Stakeholders in sustainable supply practices in case company

Code	Subcode	Illustrative quotes

Stakeholders	Retailers and customers	"Customer (retail chain) requests regarding specific ingredient requirements directly influence decisions" (Informant B).
	Suppliers and supply chain	"Requirements apply not only to us, but also to our suppliers' suppliers" (Informant B).
	Standards and certification bodies	"If we do not have standards and do not comply with them, we will not reach store shelves" (Informant C).

Sustainability impact assessment is conducted across three dimensions, environmental, social, and economic, which allows the effectiveness of SOI to be measured and provides a basis for further managerial and strategic decisions. From an environmental perspective, SOIs contribute to reducing carbon dioxide emissions, optimizing energy and water use, and decreasing waste generation. In the social dimension, innovations support employee well-being through the introduction of ergonomic work solutions, emotional well-being initiatives, and transparent communication channels. From an economic perspective, SOI are associated with efficiency improvements, cost reduction, and the creation of competitive advantages, for example through innovative packaging solutions or new sustainable products that respond to market demand. Nevertheless, the implementation of SOI is constrained by three main groups of challenges, higher financial costs, technological and infrastructural limitations to SOI implementation within the company, and the potential negative impact on final product quality. The latter challenge is particularly relevant in the food industry, where product quality and safety are critical factors. As noted by several informants (see table 12), even environmentally favorable solutions must be carefully tested, if risks to product stability or consumer trust arise, such solutions are either abandoned or their implementation is postponed.

Table 12 Impact assessment and outcomes

Code	Subcode	Illustrative quotes
Impact assessment	Environmental indicators	"In environmental protection: energy consumption per ton of production, CO_2 emissions, waste, packaging recyclability, etc." (Informant B). "Environmental, such as CO_2 emissions, energy consumption, waste and recycling rate" (Informant D).
	Social indicators	"In the social area, microclimate indices, employee turnover, number of accidents (e.g., per 1000 employees)" (Informant B); "Employee satisfaction index, involvement in emotional well-being programs, participation in community initiatives" (Informant D).
	Economic indicator	"In economics: EBITDA, sales, cost price" (Informant B); "Efficiency and cost reduction goals have an economic impact" (Informant D).

Summarizing, the findings indicate that SOI are applied across all stages of the supply chain, most prominently in production, packaging, raw material sourcing, and logistics. At the product level, the Mantinga group implements principles related to sustainable raw materials (certified and plant-based), healthier recipes, and clean-label products, while packaging solutions focus on reducing plastic use and increasing the share of recyclable and biodegradable materials. At the process level, Lean methodologies are applied to optimise time and raw material use, energy and water consumption in production is reduced, and various digitalisation solutions enable real-time monitoring of efficiency. At the organisational level, the company relies on international standards and management systems (ISO, BRCGS, IFS), integrates ESG criteria, and strengthens employee involvement and health-related programs. The key drivers of SOI originate both externally (EU and national regulations, consumer pressure) and internally (organisational culture and leadership commitment), when supply chain lead firm Mantinga group orchestrates the entire supply chain, and initiates creation and implementation of sustainability-oriented innovations. The findings

indicate that SOI practices are associated with observable sustainability outcomes. Based on company ESG data, greenhouse gas emission intensity decreased by 12.9% between 2018 and 2024, while 91.42% of waste is recycled and 87% of packaging is recyclable. Although the study does not establish causal relationships, these indicators provide supporting evidence that SOI practices are linked to improvements in environmental performance.

5. CONCLUSION AND DISCUSSION

The Mantinga Group case indicated that the implementation of SOI is more effective when it is integrated into the entire supply chain, rather than into individual processes. This allows for a systemic impact – from the selection of raw materials to the presentation of the final product. The study revealed that SOI in the company not only meets external requirements (Green Deal, other EU regulations and industrial standards, consumer expectations) but also becomes a source of competitive advantage. Analysis of primary and secondary data indicated that the implementation of SOI is most supported by management commitment, the organization's openness to innovation and the technological readiness of the company. Future research should include a more functionally diverse sample, particularly incorporating operations and supply chain management roles, to provide a more balanced view of SOI implementation.

The analysis of primary data revealed that the understanding of SOI in the case company is systematic and holistic, encompassing environmental, social, and economic dimensions. Within the company, SOI are not treated as isolated initiatives, instead, they are integrated into strategic objectives, which ensures their consistent implementation across product development, process improvements, and organisational decision-making. The analysis further indicated that SOI implementation is driven by multi-level factors, including consumer and customer needs, market trends, regulatory requirements, compliance with standards, and commitments of supply chain partners. These factors are closely linked to technological, process-related, organisational innovations, ranging from raw material selection and packaging optimisation to energy efficiency improvements, waste reduction, and employee well-being programmes. We could state that in a leading food industry company Mantinga group, SOI are perceived as a long-term foundation for competitiveness and responsibility. This means that SOI not only meet market and regulatory requirements but also become an integral part of organisational culture, shaping the company's identity and strategic direction.

The results of this study are consistent with studies that have argued that SOI transcends firm-level activities and requires coordination across supply chain actors. Previous research in manufacturing industries has highlighted that sustainability innovation depends on close collaboration with suppliers and customers, shared sustainability goals, and information exchange to achieve environmental and social outcomes (Neutzling et al., 2018). Our study indicated different approaches, that despite specific challenges, sustainability outcomes arise from companies, internal innovation rather than supply chain-level practices, especially in leading company in supply chain. These results are also significantly influenced by the regulatory environment. Thus, our findings highlight the role of a supply chain lead firm, which orchestrates the entire supply chain, in creating sustainability-oriented innovations.

Research in the automotive manufacturing industry indicates that sustainability-oriented innovation is often driven by regulatory and institutional pressures, especially in the context of environmental standards and circular economy policies (Vaz et al., 2017). Our results from the food manufacturing case are in line, as they also highlight the key role of EU regulatory initiatives, especially those related to the European Green Deal and industry specific regulation frameworks, in accelerating the supply chain-level transformation towards a circular economy.

Compared to technology-intensive industries such as automotive manufacturing, where SOI often focuses on process innovation, eco-design and reverse logistics (Dangelico & Pontrandolfo,

2015) the food industry context highlights the importance of governance, transparency in ESG reporting, sustainability reporting, management commitment, the organization's openness to innovation, technological readiness and appropriate stakeholder involvement in supply chains. This suggests that while the drivers of SOI may be similar across industries, the dominant forms of SOI and the mechanisms for its implementation vary depending on the specific characteristics of the industry.

Overall, by providing data from a global food manufacturing company in a smaller open EU economy, this study complements existing SOI research and reinforces the view that SOI is a context-dependent, supply chain-integrated process shaped by regulatory, industrial and internationalization dynamics.

This study contributes to the sustainability literature by indicating how sustainability-based innovation is embedded at the supply chain level and shaped by regulatory frameworks and governance practices. The results of the study indicate that EU sustainability regulations foster innovation and organizational transformation by influencing governance mechanisms and circular supply chain practices. Data from a global food manufacturing company from a smaller EU economy provides insights from an understudied context and indicates how companies leverage sustainability-based innovation to enhance legitimacy and competitiveness in international supply chains.

From the managerial implication perspective, the results suggest that sustainability regulations should be integrated into strategic innovation planning rather than treated as separate compliance requirements, that effective SOI requires active coordination and that integrating sustainability into supply chain activities can help support international expansion and competitive positioning.

The findings support prior research suggesting that sustainability-oriented innovation requires coordination across supply chain actors (Neutzling et al., 2018). However, this study highlights a more centralized role of the focal firm, which actively orchestrates sustainability practices across the supply chain.

Furthermore, the results confirm the importance of regulatory pressure as a key driver of SOI (Vaz et al., 2017), particularly in highly regulated industries such as food manufacturing. At the same time, the findings extend existing literature by showing that regulatory requirements can act not only as constraints but also as catalysts for innovation.

Due to the qualitative and single-case study design, the findings should be interpreted as exploratory and context-specific rather than generalizable. The study does not aim to establish causal relationships but rather to provide in-depth insights into how SOI is implemented and how it relates to sustainability performance.

Further research directions could be to examine SOI in large companies, across industries and institutional contexts, to assess the transferability of the findings. In this research, a single case study is a limitation, and we cannot generalize the results to all food companies, but the results of this study indicate trends, as leading sectoral regional firms often shape them, as they are focal firms in the supply chain, around which suppliers in their supply chain gather. Further research could focus on dynamics, assessing how sustainability-oriented innovations evolve over time, in response to regulatory changes and international expansion. Further research could also combine archival and primary data to better understand management of decision-making and stakeholder interactions. Finally, examining the impact of SOI on performance would improve understanding of their strategic value in global supply chains.

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