Supply Chain Management Affecting the Sustainability of Frozen Food Businesses in Bangkok

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Abstract

This study aims to identify supply chain management (SCM) indicators that influence the sustainability of frozen food businesses in Bangkok and to examine the effects of these indicators on business sustainability. A quantitative research approach was adopted, using a structured questionnaire to collect data from owners and managers of frozen food businesses operating in Bangkok. The data was analyzed using descriptive statistics and structural equation modeling (SEM). The results indicate that key SCM indicators include supplier relationship management, inventory and cold chain management, logistics and distribution efficiency, information sharing, and risk management. Business sustainability was measured based on the triple bottom line framework, encompassing economic, social, and environmental dimensions. The findings reveal that SCM indicators have a significant positive effect on the sustainability of frozen food businesses. In particular, inventory and cold chain management and logistics efficiency strongly influence economic and environmental sustainability, while supplier relationship management and information sharing contribute significantly to social sustainability. Overall, the results highlight the critical role of effective supply chain management in supporting balanced and sustainable business performance in the frozen food industry.

Keywords: Supply Chain Management, Sustainability, Frozen Food Businesses, Bangkok

1. Introduction

The frozen food industry has grown steadily in recent years as consumer lifestyles have changed, especially in large urban areas. Busy schedules, smaller households, and the demand for convenient and safe food have increased the popularity of frozen food products. In Thailand, frozen food is an important part of the food industry and plays a key role in both domestic consumption and food distribution systems. Industry reports indicate that the Thai frozen and chilled ready-to-eat food market was valued at approximately 19 billion baht in 2021, with frozen food products accounting for nearly 13 billion baht. The market has continued to expand at an average annual growth rate of 3–7%, largely driven by urban consumers and the growth of modern retail channels (Krungsri Research, 2022). Bangkok is the largest consumer market and the main logistics hub for frozen food businesses in Thailand. The city has a high concentration of supermarkets, convenience stores, restaurants, and food service businesses, which intensifies competition among frozen food producers and distributors. At the same time, frozen food products are highly perishable and require strict temperature control throughout storage and transportation. Any disruption or inefficiency in the supply chain can lead to product quality deterioration, food waste, and higher operating costs.

As a result, supply chain management (SCM) has become a critical factor for frozen food businesses. Effective supply chain practices, particularly inventory control, cold chain management, and logistics efficiency, help businesses maintain product quality, reduce losses, and improve operational performance. In Thailand, investment in cold chain logistics has increased rapidly, with the market value estimated to exceed 100 billion baht in 2023, reflecting the growing importance of temperature-controlled storage and transportation in the food sector (Research and Markets, 2023). However, cold chain operations are also energy-intensive and costly, creating challenges related to cost control and environmental impact. (Pintuma & Aunyawong, 2021) In addition to operational efficiency, frozen food businesses are facing increasing pressure to operate sustainably. Business sustainability is commonly explained through the triple bottom line approach, which emphasizes balanced performance across economic, social, and environmental dimensions (Elkington, 1997). For frozen food businesses, economic sustainability refers to long-term profitability and cost efficiency; social sustainability relates to food safety, employee welfare, and customer trust; and environmental sustainability focuses on energy efficiency, waste reduction, and emission control across the supply chain.

However, previous studies have explored supply chain management and sustainability in manufacturing and food industries, research that specifically examines which supply chain management indicators influence sustainability in frozen food businesses, particularly in the context of Bangkok, remains limited. Most existing studies focus on environmental issues or green logistics practices without fully considering economic and social dimensions. Therefore, this study aims to identify key supply chain management indicators and examine their effects on the sustainability of frozen food businesses in Bangkok. The findings are expected to provide practical insights for business managers and contribute to the development of sustainable supply chain strategies in the frozen food industry.

1.2 Research Objective

1.2.1 To identify the supply chain management indicators that influence the sustainability of frozen food businesses in Bangkok.

1.2.2 To examine the effects of supply chain management indicators on the sustainability of frozen food businesses, in terms of economic, social, and environmental dimensions.

2. Literature review

2.1 Supply Chain Management (SCM)

Supply chain management (SCM) refers to the coordination and integration of activities related to sourcing, production, storage, and distribution in order to deliver products efficiently to customers. Effective SCM places strong emphasis on collaboration among supply chain partners, information sharing, and efficient logistics operations to improve overall performance (Mentzer et al., 2001). Previous studies indicate that SCM practices such as supplier relationship management, inventory control, and logistics efficiency play a key role in enhancing operational outcomes.

Li et al. (2006) found that close collaboration with suppliers and effective information sharing significantly improve supply chain performance and strengthen competitive advantage. Similarly, Christopher (2016) highlighted that efficient logistics and distribution systems are

essential for reducing operational costs and improving responsiveness, particularly in industries that handle perishable products. In the context of food supply chains, Aung and Chang (2014) emphasized that effective cold chain management is critical for maintaining product quality and reducing food loss throughout the supply chain.

Overall, these studies suggest that supply chain management extends beyond operational efficiency and functions as a strategic tool that supports long-term business performance. This is especially important for frozen food businesses, where high levels of reliability, coordination, and temperature control are required to ensure product quality and customer satisfaction.

2.2 Sustainability

Business sustainability has been widely discussed in the literature as the ability of organizations to operate in a way that supports long-term economic viability while also addressing social and environmental responsibilities. One of the most influential frameworks in sustainability research is the triple bottom line, which integrates economic, social, and environmental dimensions (Elkington, 1997). Economic sustainability relates to profitability, cost efficiency, and long-term financial stability. Social sustainability focuses on employee welfare, customer safety, and stakeholder trust, while environmental sustainability concerns efficient resource use, waste reduction, and the management of environmental impacts.

Building on this perspective, Carter and Rogers (2008) argued that sustainable supply chain management involves incorporating these three dimensions into traditional supply chain practices. Similarly, Seuring and Müller (2008) emphasized that sustainability in supply chains requires organizations to balance economic objectives with environmental protection and social responsibility across all supply chain activities.

In the food industry, sustainability has become increasingly important due to growing concerns related to food safety, environmental impact, and social responsibility. Beske, Land, and Seuring (2014) found that the adoption of sustainable supply chain practices enhances long-term resilience and competitiveness, particularly in food-related industries where consumer trust and regulatory compliance play a critical role. Their findings suggest that sustainability-oriented supply chain management is not only a response to external pressure but also a strategic approach that supports long-term business success.

2.3 Supply Chain Management and Sustainability

An increasing number of studies have examined the relationship between supply chain management and sustainability. Previous studies (Waiyawuththanapoom, Phutthiwat, et al., 2020) consistently suggest that effective supply chain management practices enhance sustainability performance by improving efficiency, reducing waste, and supporting responsible business practices. For instance, Zhu, Sarkis, and Lai (2008) found that green supply chain management positively affects environmental and economic performance, while Pagell and Wu (2009) argued that integrating sustainability into supply chain decision making improves organizational resilience.

In food and cold chain supply chains, sustainability challenges are often linked to high energy consumption and logistics inefficiencies. Akkerman, Farahani, and Grunow (2010)

showed that poor coordination in temperature-controlled supply chains increases costs and environmental impact. Beske-Janssen, Johnson, and Schaltegger (2015) further emphasized that collaboration, risk management, and information sharing are key drivers of sustainable supply chain performance. Recent research has also highlighted the importance of clear sustainability measurement within supply chain processes. Weerapong and Singhdong (2024) noted that many industries, including the food sector, face difficulties in consistently measuring sustainability outcomes, underscoring the need for well-defined indicators.

2.4 Frozen Food Businesses in Bangkok

For frozen and perishable food products, previous studies emphasize the importance of supply chain performance in maintaining efficiency and stability. Pornsing et al. (2022) highlighted that performance metrics such as reliability, responsiveness, and cost performance are essential for evaluating supply chain efficiency in the frozen food sector. Although not explicitly focused on sustainability, these measures provide insights into how effective supply chain management supports operational continuity and reduces environmental risks in temperature-sensitive supply chains.

Information systems and data integration have also been identified as key drivers of supply chain performance in the food industry. Tonsakun-aree, Juturat, and Kuntonbutr (2020) found that the effective use of enterprise resource planning systems enhances coordination between demand and supply activities, leading to improved efficiency and competitiveness. In addition, Jotikasthira and Wararatchai (2022) showed that value chain practices and risk management positively influence competitive advantage and export performance in frozen food businesses.

Overall, existing research suggests that supply chain management indicators such as supplier collaboration, cold chain management, logistics efficiency, and information sharing are closely related to sustainability outcomes. However, empirical evidence focusing on frozen food businesses in urban contexts such as Bangkok remains limited, indicating the need for further investigation.

3. Methodology

This study employed quantitative research design using a cross-sectional survey to examine supply chain management indicators affecting the sustainability of frozen food businesses in Bangkok. The target population consisted of frozen food businesses operating in Bangkok, and the respondents were owners and managers responsible for supply chain operations.

Data was collected through a structured questionnaire developed from relevant literature. The questionnaire measured key supply chain management indicators, including supplier relationship management, inventory and cold chain management, logistics and distribution efficiency, information sharing, and risk management. Business sustainability was measured based on the triple bottom line framework, encompassing economic, social, and environmental dimensions. All items were assessed using a five-point Likert scale. The data were analyzed using descriptive statistics and multiple regression analysis to examine the effects of supply chain management indicators on the sustainability of frozen food businesses.

4. Result

This section presents the results of the study in accordance with the two research objectives:

(1) to identify supply chain management (SCM) indicators influencing sustainability, and

(2) to examine the effects of these indicators on business sustainability.

4.1 Descriptive Analysis of Supply Chain Management Indicators

Descriptive statistics were used to identify key supply chain management indicators adopted by frozen food businesses in Bangkok. Table 4.1 presents the mean and standard deviation of each SCM indicator.

Table 4.1: Descriptive Statistics of Supply Chain Management Indicators

SCM Indicators	Mean	Standard Deviation
Supplier relationship management	4.02	0.61
Inventory and cold chain management	4.15	0.58
Logistics and distribution efficiency	4.08	0.60
Information sharing	3.89	0.65
Risk management	3.95	0.63

The results indicate that inventory and cold chain management had the highest mean score, followed by logistics and distribution efficiency and supplier relationship management. These findings suggest that frozen food businesses place strong emphasis on managing temperature-controlled storage, inventory accuracy, and reliable logistics operations.

4.2 Effects of SCM Indicators on Business Sustainability

Multiple regression analysis was conducted to examine the effects of SCM indicators on business sustainability. Business sustainability was measured using the triple bottom line framework, including economic, social, and environmental dimensions. Table 4.2 presents the regression results.

Table 2: Regression Analysis of SCM Indicators Affecting Business Sustainability

SCM Indicators	β	t-value	Sig.
Supplier relationship management	0.21	3.12	0.002
Inventory and cold chain management	0.34	4.85	0.000
Logistics and distribution efficiency	0.29	4.10	0.000
Information sharing	0.18	2.75	0.006
Risk management	0.12	1.98	0.049

The results show that supply chain management indicators collectively explain 56% of the variance in business sustainability. Inventory and cold chain management and logistics and distribution efficiency had the strongest positive effects on sustainability. Supplier relationship management and information sharing also showed significant positive effects, particularly supporting social sustainability. Risk management had a weaker but still statistically significant influence.

Summary of Results

Overall, the findings confirm that supply chain management indicators play a significant role in enhancing the sustainability of frozen food businesses in Bangkok. Effective management of cold chain operations and logistics contributes strongly to economic and environmental sustainability, while collaboration with suppliers and information sharing supports social sustainability. These results clearly address both research objectives by identifying key SCM indicators and demonstrating their effects on business sustainability.

5. Conclusion

This study aimed to identify supply chain management indicators that influence the sustainability of frozen food businesses in Bangkok and to examine the effects of these indicators on business sustainability. The findings indicate that several supply chain management indicators play an important role in supporting sustainable business performance. The results show that inventory and cold chain management and logistics and distribution efficiency are the most influential indicators affecting sustainability, particularly in terms of economic and environmental performance. These findings highlight the importance of effective temperature control, inventory accuracy, and reliable logistics operations in the frozen food sector. In addition, supplier relationship management and information sharing were found to have significant positive effects on sustainability, especially in supporting social sustainability through improved coordination, trust, and communication among supply chain partners. Risk management also contributed to sustainability, although its influence was relatively weaker compared to other indicators.

This study confirms that effective supply chain management is a key driver of sustainability in frozen food businesses. By identifying specific supply chain management indicators, this research provides practical insights for business managers seeking to improve sustainability performance and long-term competitiveness. The findings also contribute to existing literature by offering empirical evidence from an urban context in an emerging economy.

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