

# The Role of Integration Processes on Supply Chain Flexibility and Supply Chain Agility in a Dynamic Environment: Evidence from the Food and Beverage Manufacturing in Indonesia

Andrina Agung Ayu Puty<sup>1</sup>, Sutrisno, Timotius F.C.W.<sup>1\*</sup>

<sup>1</sup> Universitas Ciputra Surabaya, CitraLand CBD Boulevard, Surabaya, Indonesia

\*Corresponding Author: [timotius.feby@ciputra.ac.id](mailto:timotius.feby@ciputra.ac.id)

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**Abstract:** *This research examines how integrating processes affects the flexibility and agility of supply chains within Indonesia's food and beverage sector, considering the moderating effect of a dynamic environment. Data were gathered from 107 companies in Indonesia's food and beverage sector using purposive sampling technique. A structured questionnaire gathered insights on process integration, supply flexibility, supply chain agility, and the dynamic environment. Statistical methods analyzed the relationships among these variables. Process integration positively influences supply chain flexibility and agility in Indonesia, moderated by a dynamic environment. However, the direct impact of supply flexibility on supply chain agility and the moderating role of a dynamic environment between process integration and supply flexibility were not supported. This study centers on the food and beverage industry in five Indonesian provinces with major port hubs. The findings may not apply to other sectors or regions. Emphasizing process integration within food and beverage companies enhances flexibility and agility, especially in dynamic environments. Prioritizing supply chain integration improves responsiveness to market changes and customer needs. This research offers concrete evidence on the essential role of process integration in improving supply chain flexibility and agility, emphasizing the influence of a dynamic environment as a moderating factor. This offers valuable insights for researchers and practitioners.*

**Keywords:** Food and Beverage Manufacturing, Process Integration, Supply Chain Flexibility, Supply Chain Agility, Dynamic Environment

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## 1. Introduction

In the context of the rapidly evolving business landscape within the food and beverage sector, the capacity for companies to quickly adapt to customer needs and market trends is crucial. Prior studies have highlighted the significance of adopting integrated processes to address the constantly shifting preferences of consumers, emphasizing the need for unique product offerings and improved customer experiences (Murillo-Oviedo et al., 2019). In this industry, unpredictable demand often leads to mismatches between supply and demand, necessitating a responsive supply chain (Guo et al., 2023). For example, some of Indonesia's largest food manufacturers faced a sudden surge in demand for instant noodles during the COVID-19 pandemic, requiring a swift increase in production capacity to meet market needs. This scenario underscores the critical need for supply flexibility and effective process integration to maintain agility and performance in a highly regulated and dynamic industry (Jum'a & Bushnaq, 2024).

To achieve this level of responsiveness, companies in the food and beverage industry must focus on process integration, which involves the coordination and alignment of various functions such as procurement, production, and distribution to optimize overall performance (Chatha et al., 2024). Companies implement process integration through the use of advanced planning and scheduling systems to align production schedules with demand forecasts, thereby reducing lead times and inventory costs. Additionally, enterprise resource planning systems are commonly utilized to integrate information flows across departments, ensuring that all parts of the organization are synchronized in real-time (Patil et al., 2024). The real-time synchronization is crucial not only for maintaining product quality and meeting regulatory standards, but also for quickly adapting to market shifts, as demonstrated during the pandemic. Cross-functional process integration within companies is essential for improving supply flexibility, particularly for food and beverage manufacturers operating in dynamic environments. Internal collaboration is vital for generating market intelligence and enhancing supply chain agility (Wikamulia & Isa, 2023). This integration is essential not only for enhancing supply flexibility but also for significantly influencing overall supply chain performance (Haq & Aslam, 2022). By strategically collaborating with partners, companies can streamline the flow of products and services, thereby efficiently meeting customer demands and navigating market changes. This aligns with previous findings that supply chain learning and process integration significantly improve production flexibility and overall performance, especially in manufacturing industries within developing countries (Meidute-Kavaliauskiene et al., 2022).

Supply flexibility in food and beverage companies is therefore crucial for adapting to uncertainties and enhancing supply chain agility. Studies have shown that supply chain partnerships, customer orientation, and flexibility play significant roles in the operational performance of food service companies (Nagy & Jám bor, 2022). The integration of external and internal information is a key factor in enhancing both reactive and proactive supply flexibility, ultimately improving operational performance in the Chinese food industry (Ku et al., 2016). Moreover, dynamic capabilities such as sensing skills, flexibility, communication, and coordination are vital for effectively managing risks, illustrating the need for operational capabilities that extend beyond traditional supply chain management (Meidute-Kavaliauskiene et al., 2022). These capabilities are particularly relevant in the context of developing countries like Indonesia, where companies must navigate complex and often unpredictable environments.

These challenges underscore the need for empirical research to understand how companies attain supply chain agility at varying levels of product complexity. This study aims to answer two primary research questions: First, what is the impact of process integration on supply flexibility and supply chain agility? Second, how does a dynamic environment influence the relationship between process integration, supply flexibility, and supply chain agility? Using survey data from 107 companies in Indonesia's food and beverage industry, this study provides valuable insights and contributes to both theory and practice by examining the specific contexts and themes within the industry related to process integration, flexibility, and supply chain agility, particularly within the dynamic environment of developing countries like Indonesia.

## **2. Literature Review**

### **2.1 Grand Theory**

The literature review is grounded in the Dynamic Capability View (DCV), which emphasizes a firm's ability to sense, seize, and respond to environmental changes (Wu, 2010). Within the

context of supply chain agility, DCV posits that firms must develop and deploy dynamic capabilities—such as process integration and supply flexibility—to remain competitive in a rapidly changing environment. This theory suggests that firms can enhance agility by investing in collaborative relationships and leveraging internal competencies, which are crucial for detecting and capitalizing on opportunities for innovation and competitive advantage (Chen et al., 2014; Mikalef & Pateli, 2017). Recent studies emphasize that collaborative partnerships and internal competencies are key drivers of supply chain agility, especially in dynamic industries (Dubey et al., 2024). The dynamic environment serves as both a challenge and an opportunity, where firms that effectively integrate their processes and enhance their supply flexibility are better positioned to achieve supply chain agility (Rahim, 2024). The integration of processes and the enhancement of supply flexibility are increasingly recognized as essential strategies for achieving supply chain agility in volatile markets (Bai, 2024). This theoretical perspective is particularly relevant to this study, which explores the moderating role of a dynamic environment in the relationship between process integration, supply flexibility, and supply chain agility, underscoring the importance of adaptability and proactive management in maintaining agility amid external pressures.

## 2.2 Supply Chain Agility

Supply chain agility is a strategic capability allowing businesses to rapidly detect and address both external and internal uncertainties (Hsieh et al., 2023). This agility transforms challenges and changes into opportunities, fostering sustainable success in a dynamic business landscape (Fayezi et al., 2013). Supply chain agility marks a transition from traditional lean and functional supply chains to those that are more agile and customized, characterized by responsiveness to market conditions, integration of processes and networks, and cybernetic collaboration (Christopher & Towill, 2001; Jia et al., 2020). It evaluates a supply chain's responsiveness to external changes, setting it apart from internal capabilities and performance drivers (Azwan & Shukor, 2020; Swafford et al., 2006; Zaki, 2024).

The notion of agility originated from agile manufacturing systems, which were designed to reduce lead times and accommodate fluctuations in product variety and volume (Scholten et al., 2010). Over time, agility evolved into a complex, multidimensional concept encompassing organizational contexts and entire supply chains (Li et al., 2008). In business, agility is viewed as a multidimensional concept that includes customer, internal, external, partnering, and supply chain agility (Braunscheidel & Suresh, 2009; Gligor et al., 2015; Huo et al., 2018; Li et al., 2009). Thus, supply chain agility includes managing customer relationships effectively in complex situations and working closely with suppliers and stakeholders to quickly address disruptions in demand (Chan et al., 2017; Eckstein et al., 2015).

Viewed through the lens of dynamic capabilities, supply chain agility is defined as the ability to rapidly and flexibly detect and respond to immediate changes by effectively combining internal and external expertise (Ghasemaghahi et al., 2017; Teece et al., 2008). This involves detecting changes, seizing opportunities and threats, and transforming routines and resources to adapt to uncertain environments (Altay et al., 2018; Aslam et al., 2018). Supply chain agility thus supports long-term profitability and competitiveness by enabling firms to meet global market demands, especially in high-velocity and uncertain environments, ensuring effective responses to disruptions and changing conditions (Lee, 2021).

## **2.3 Enablers of Supply Chain Agility**

### **2.3.1 Supply Flexibility**

Supply flexibility refers to the supply chain's capacity to adjust to shifting market demands with minimal disruption (Arawati, 2011; Thuy, 2023). It involves various dimensions, including product and volume flexibility, which enable organizations to respond effectively to dynamic customer needs (Thomé et al., 2014). Supply flexibility is crucial for organizations to remain competitive, as it allows them to adjust their operations to both internal and external market conditions (Yi et al., 2011; Yousuf et al., 2023). This flexibility extends across multiple dimensions within the supply chain, including manufacturing, strategic, IT, sourcing, and external flexibility (Chan et al., 2017; Lee & Wang, 2013; Swafford et al., 2006; Wagner et al., 2018). Supply-side flexibility in volume and mix is crucial for vendors to adapt manufacturing processes to changing market needs (Gosling et al., 2010).

Overall, supply flexibility is essential for organizations to achieve supply chain agility and competitiveness. It allows firms to efficiently produce a combination of products and operate at various output levels without compromising product and service quality (Zhang et al., 2003). Supply flexibility offers advantages such as addressing demand uncertainties, minimizing lead times, and improving overall supply chain agility. Therefore, investing in supply flexibility is essential for organizations to adapt and thrive in dynamic market environments, ultimately leading to improved performance and competitiveness (Chan et al., 2017; Darmawan et al., 2023; Haq & Aslam, 2022).

### **2.3.2 Process Integration**

Process integration is the cohesive merging of various functions and activities within a business to enhance overall performance and responsiveness to dynamic market demands. It entails aligning operations, management elements, and business procedures to achieve excellent performance (Cooper et al., 1997). Process integration entails collaborative efforts among business entities, encompassing marketing, sales, information exchange, and product development (Bowersox & Daugherty, 1987). Furthermore, successful process integration hinges on internal operations like fulfilling orders and developing products, as well as essential processes such as managing customer relationships, forecasting demand, and innovating new products (Hewitt, 1992).

Within the broader concept of process integration, a critical dimension involves integrating activities and exchanging information (Kim & Calantone, 2006; Rai et al., 2006). Activity integration involves collaborative planning and forecasting among partners, facilitated by robust interfirm communication systems (Philipsen et al., 2008). This collaborative approach enables firms to adjust strategies efficiently in response to market fluctuations. Furthermore, business process integration particularly within order and distribution processes plays a significant role in overall process integration. (Coughlan et al., 2006), enabling integrated performance management and fostering trust-based relationships (Papakiriakopoulos & Pramadari, 2010). It encompasses degrees of integration ranging from basic coordination to high-level collaboration (Spekman et al., 1998).

### **2.3.3 Dynamic Environment**

In today's business landscape, characterized by frequent and unpredictable changes, companies must navigate these shifts with both agility and strategic foresight. This necessitates a reevaluation of how resources are allocated, often leading firms to build strong inter-organizational networks to stay informed about critical developments (Belhadi et al., 2024). Operating in dynamic environments means organizations must swiftly adapt to changes and

proactively anticipate potential disruptions. Eisenhardt and Martin (2000) emphasize that dynamic capabilities are essential in such scenarios, allowing companies to reconfigure their resources and processes to remain competitive. Additionally, the capacity to integrate and coordinate supply chain activities quickly enhances both flexibility and responsiveness, which are crucial for managing the uncertainty and complexity inherent in these environments (Lee & Moon, 2024; Rehman & Jajja, 2023). Partnerships with supply chain collaborators facilitate the use of shared expertise and resources, enhancing the ability of firms to navigate environmental volatility (Mentzer et al., 2000). Thus, the combination of dynamic capabilities and inter-organizational networks becomes a key strategy for maintaining performance in rapidly changing markets. Consequently, exploring the role of integration processes in enhancing supply chain flexibility and agility is critical for success in a dynamic environment, as these processes ensure timely and efficient responses to market fluctuations (Tece, 2014).

## **2.4 Research Hypotheses**

### **2.4.1 Relationship between Process Integration and Supply Flexibility**

Process integration within supply chains is crucial for improving supply flexibility by facilitating better coordination among various supply chain activities (Braunscheidel & Suresh, 2009; Chaudhuri et al., 2018; Flynn et al., 2010; Irfan et al., 2019; Meidute-Kavaliauskiene et al., 2022). Research indicates that effective process integration bolsters a company's capacity to adjust to shifts in market demand and handle fluctuations in product volume (Alsawalhah, 2020; H. Chen et al., 2009; Roh et al., 2013). In the context of the food and beverage industry, supply chain integration is essential for improving operational performance and optimizing costs by enhancing collaboration among different stakeholders, including suppliers, manufacturers, and distributors (Devaraj et al., 2007; Frohlich & Westbrook, 2001; Vickery et al., 2003). Well-implemented process integration helps to avoid operational inefficiencies that can hinder supply flexibility (Simatupang et al., 2002). Further studies show that process integration not only supports the optimization of production processes and inventory management but also enhances a company's capability to react more quickly and efficiently to market dynamics, thereby increasing competitiveness (Huo et al., 2014; Irfan et al., 2019; Liu et al., 2015; Siagian et al., 2022; Wu et al., 2006). Thus, process integration facilitates better production planning and demand forecasting while enabling companies to tailor their products to market requirements, thereby achieving flexibility in product variety and volume (Blome et al., 2014; Braunscheidel & Suresh, 2009; Keddari et al., 2018; Swafford et al., 2006).

Accordingly, the following hypothesis is put forward:

H1: Process integration is significantly related to supply flexibility

### **2.4.2 Relationship between Supply Flexibility and Supply Chain Agility**

Supply flexibility is crucial in reducing processing times and enhancing vendor responsiveness due to its impact on both volume and variety (Azwan & Shukor, 2020; Dubey et al., 2020; Kamalahmadi et al., 2021). Consequently, this leads to higher supply chain agility. Supply flexibility empowers organizations to effectively manage issues such as varying customer demands, complexities within the supply chain, competitive pressures, and cultural changes. This capability significantly improves their ability to meet deadlines and respond promptly to customer needs (Čiarnienė & Vienažindienė, 2014; Siagian et al., 2022). Recent research highlights that supply flexibility, particularly concerning product volume and type, allows firms to optimize internal resource utilization and reduce production lead times, facilitating quicker and more efficient responses to market demands (Dubey et al., 2020). Additionally, the ability to flexibly adjust to variations in product mix or volume enhances relationships between buyers and suppliers, ultimately improving overall supply chain responsiveness



(Azwan & Shukor, 2020). Supply flexibility not only impacts internal operational efficiencies but also significantly contributes to improving responsiveness to customer demands (Basana et al., 2023; Siagian et al., 2022). Thus, the effective combination of volume and variety flexibility with supply chain integration enhances a firm's capability to swiftly respond to dynamic business environment changes, forming the foundation for heightened supply chain agility (Braunscheidel & Suresh, 2009; Frohlich & Westbrook, 2001; Gligor & Holcomb, 2014).

Accordingly, the following hypothesis is put forward:

H2: Supply flexibility is significantly related to supply chain agility

#### **2.4.3 Relationship between Process Integration and Supply Chain Agility**

Process integration within the supply chain is vital for improving agility by facilitating quicker responses to market changes and developing superior flexibility and customer agility (Atmaja et al., 2022; Demeter et al., 2016; Irfan et al., 2019; Mate, 2022). Research indicates that effective process integration can accelerate decision-making processes and improve response speeds for both customers and manufacturing, ultimately creating significant competitive advantages across all aspects of business operations (Chiang et al., 2012; Wu et al., 2017). This indicates that process integration enables companies to be more agile in response to sudden external changes, such as raw material price fluctuations and rapid shifts in market demand (Irfan et al., 2019; Mate, 2022; Nazir & Pinsonneault, 2021). In the food and beverage sector, which is tightly regulated and influenced by dynamic consumer trends, this capability is particularly critical. Rapid response to market demands and timely delivery are essential to maintaining product quality. The ability to quickly adapt to changes in consumer demand and market dynamics is a critical factor (Chen et al., 2009). Here, process integration plays a vital role in ensuring efficiency in raw material processing and distribution, reducing waste, mitigating operational and specific market risks, and improving supply chain agility (Atmaja et al., 2022; Zhao et al., 2013).

Accordingly, the following hypothesis is put forward:

H3: Process integration is significantly related to supply chain agility

#### **2.4.4 The Moderating Role of a Dynamic Environment on Process Integration and Supply Flexibility**

In the food and beverage industry, supply flexibility is particularly essential due to the perishable nature of products and fluctuating demand patterns. Studies indicate that supply chain agility, facilitated by supply flexibility, is vital for maintaining product quality and promptly meeting customer demands (Gligor & Holcomb, 2014). A recent analysis highlights that dynamic supply chain capabilities, including flexibility, are critical for operational performance in the food and beverage sector (Siagian et al., 2022). This adaptability helps firms navigate supply chain disruptions, ensuring resilience and sustained performance even during challenging times. Enhanced supply flexibility in this sector leads to reduced lead times and improved service levels, which are critical for maintaining competitiveness and customer satisfaction (Huo et al., 2018). The dynamic environment of this industry requires a flexible supply chain to quickly adapt to shifting consumer preferences and market conditions (Siagian et al., 2022).

Process integration plays a critical role in enhancing supply chain responsiveness and adaptability to the dynamic environment. Integrating processes across various stages of the supply chain enables real-time data sharing and communication, which are essential for quick decision-making and agile responses to market changes. This integration helps synchronize operations from procurement to distribution, facilitating smoother adjustments to fluctuating demand (Flynn et al., 2010). Furthermore, process integration fosters collaboration among supply chain partners, thereby enhancing the overall flexibility and responsiveness of the supply chain network (Irfan et al., 2019). By effectively integrating processes, firms can achieve greater agility in adapting to the dynamic environment of the food and beverage industry, thereby supporting the connection between process integration and supply flexibility. Accordingly, the following hypothesis is put forward:

H4: Dynamic environment moderates the effect of process integration on supply flexibility

#### **2.4.5 The Moderating Role of a Dynamic Environment on Process Integration and Supply Chain Agility**

In a dynamic environment characterized by constant change and uncertainties, effective process integration is crucial for enhancing supply chain agility. This integration involves seamless coordination and cooperation between internal departments and external stakeholders, mitigating the adverse effects of environmental uncertainties (Leuschner et al., 2013; Rehman & Jajja, 2023). Achieving high process integration allows businesses to respond quickly and flexibly to market fluctuations and unpredictable situations, thus improving supply chain agility (Prater et al., 2001; Swafford et al., 2006). The dynamic environment moderates the effect of process integration on supply chain agility by emphasizing the need for businesses to adapt their strategies to manage unpredictability effectively, ultimately improving flexibility and business performance (Y. Chen & Xiao, 2023; Lyu et al., 2022; Wong et al., 2011). Therefore, in a dynamic environment, integrating processes helps businesses cope with uncertainties and significantly contributes to their agility and competitiveness in the supply chain (Welker et al., 2008; Wong & Boon-Itt, 2008). This approach ensures businesses are better equipped to handle rapid market changes, leading to superior performance and sustainability (Koç et al., 2022).

Accordingly, the following hypothesis is put forward:

H5: Dynamic environment moderates the effect of process integration on supply chain agility

#### **2.4.6 The Moderating Role of a Dynamic Environment on Supply Flexibility and Supply Chain Agility**

Uncertainty and rapid changes in a dynamic environment affect how companies make decisions and manage their supply chains (Duncan, 1972; Flynn et al., 2016; Qi et al., 2011). Supply flexibility, which includes the ability to adjust product volume and variety, is crucial for responding to market demand changes and dynamics, such as those frequently encountered in the food and beverage industry where demand fluctuations are common (C.-J. Chen, 2019). In a rapidly changing environment, supply flexibility enables firms to efficiently adjust their operations to respond to demand fluctuations (Swafford et al., 2006; Yousuf et al., 2023). The increased complexity of the supply chain in a dynamic environment makes supply flexibility a significant competitive advantage (Haq & Aslam, 2022; Welker et al., 2008; Wong & Boon-Itt, 2008). Integrating supply flexibility with agile supply chain strategies helps firms respond to market changes more quickly and effectively (Braunscheidel & Suresh, 2009; Frohlich & Westbrook, 2001). Therefore, the dynamic environment is crucial in determining the

effectiveness of supply flexibility in enhancing supply chain agility, as the organization's adaptability to environmental changes directly impacts the efficacy of supply flexibility in improving supply chain agility (Swafford et al., 2006).

Accordingly, the following hypothesis is put forward:

H6: Dynamic environment moderates the effect of supply flexibility on supply chain agility

### 2.4.7 The Mediating Role of a Supply Flexibility on Process Integration and Supply Chain Agility

In the development of the food and beverage industry, supply flexibility significantly enhances the effectiveness of process integration by enabling firms to swiftly adapt to market fluctuations and disruptions (Haq & Aslam, 2022). This adaptability is crucial for improving supply chain agility, especially in an industry where product shelf-life, customer preferences, and regulatory standards frequently change (Dubey et al., 2024). A firm with high supply flexibility can efficiently scale production, alter sourcing strategies, or reroute distribution channels, thereby maintaining agility even in volatile conditions (Minguela-Rata et al., 2024). Moreover, Aslam et al. (2024) emphasize that supply flexibility not only supports integrated processes under stable conditions, but also enhances their ability to adapt to external changes. This capability ensures that the benefits of process integration are fully leveraged, allowing the entire supply chain to function cohesively and effectively respond to new demands or disruptions (Jiang et al., 2024). By strengthening the adaptive capacity of integrated processes, supply flexibility ensures that firms can maintain operational continuity and efficiency, thereby boosting overall supply chain agility in dynamic environments like the food and beverage industry (Singh, 2024).

Accordingly, the following hypothesis is put forward:

H7: Supply flexibility mediates the effect of process integration on supply chain agility.

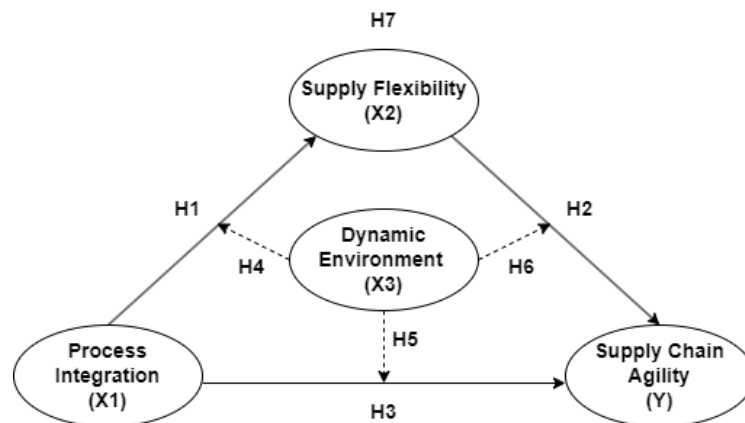


Figure 1: Conceptual Framework

### 3. Method

This study collected data from companies in the food and beverage industry across Indonesia, chosen for its dynamic nature and significant role in the country's economy, making it an ideal context for examining the impact of process integration on supply chain flexibility and agility. The study utilized a seven-point Likert scale, with responses ranging from 1 ("strongly



disagree") to 7 ("strongly agree"). To ensure that the data collected was both representative and relevant, purposive sampling techniques were employed. Participants were carefully selected from companies within the food and beverage sector, specifically focusing on food manufacturing, beverage manufacturing, and logistics/supply chain services directly related to food and beverage operations. The study also targeted companies of various scales, including small businesses, medium-sized enterprises, and large corporations, defined based on the number of employees and annual revenue.

Respondents were chosen from key managerial positions, such as directors, managers, and supervisors, to ensure that the data reflected strategic and operational decision-making perspectives. A minimum of 1-5 years of industry experience was required of respondents, ensuring that participants had sufficient knowledge and experience to provide informed insights into supply chain practices and challenges. This study centered on the food and beverage industry in five Indonesian provinces with major port hubs, including East Java, West Java, Bali, West Sumatera, and South Sulawesi, to ensure a geographically representative sample. The research team identified and approached companies that met the predefined criteria through industry directories, professional networks, and trade associations related to the food and beverage sector.

Questionnaires were distributed electronically via Telegram platform network to IPOMS (Indonesian Production & Operations Management Society) members from April 2024 to May 2024. The initial question in the Google Form confirmed respondents' involvement in the food and beverage sector, ensuring relevance to the study. Multiple reminders were sent to ensure a high response rate. In total, 107 valid responses were obtained, providing a comprehensive dataset for analysis. The collected data covered key topics such as process integration, supply chain flexibility, and agility, along with demographic questions. Responses were reviewed for completeness and relevance, ensuring that only valid responses were included in the analysis. This rigorous data collection process allowed the study to gather high-quality responses from experienced professionals, providing valuable insights into supply chain management within the food and beverage industry in Indonesia.

## 4. Findings

### 4.1 Sample Demographic Profile

The demographic profile of the sample is summarized in Table 1. This information includes details on the business scale, number of employees, respondents' positions, industry experience, the types of companies they represent, and geographical location. Understanding the demographic characteristics of the sample is crucial for contextualizing the study's findings. This demographic information ensures a comprehensive understanding of the company and respondents' backgrounds, confirming the significance and applicability of the research results to Indonesia's food and beverage sector.

**Table 1: Sample Demographic Profile**

Criteria	Category	Frequency	Percentage
Business Scale	Small business	21	20%
	Medium-sized enterprise	54	50%
	Large corporation	32	30%
Number of Employees	0-500	59	55%
	500-1000	27	25%
	>1000	21	20%

Position	Director	25	23.4%
	Manager	50	46.7%
	Supervisor	32	29.9%
Industry Experience	1-5 years	30	28.0%
	6-10 years	45	42.1%
	>10 years	32	29.9%
Company Type	Food Manufacturing	57	53.3%
	Beverage Manufacturing	30	28.0%
	Logistics/Supply Chain	20	18.7%
Geographical Location	East Java	37	35%
	West Java	27	25%
	Bali	16	15%
	West Sumatera	16	15%
	South Sulawesi	11	10%

Note: n=107

#### 4.2 Reliability and Validity

The study's findings provide substantial insights into the relationships between process integration, supply flexibility, dynamic environments, and supply chain agility:

**Table 2: Results of Reliability and Validity of Measurement**

Constructs	Item	Factor loading	AVE	Cronbach's $\alpha$	CR
Process Integration (X1)	X1.1	0.767	0.586	0.882	0.908
	X1.2	0.769			
	X1.3	0.790			
	X1.4	0.755			
	X1.5	0.715			
	X1.6	0.730			
	X1.7	0.826			
Supply Flexibility (X2)	X2.1	0.866	0.762	0.843	0.905
	X2.2	0.901			
	X2.3	0.850			
Dynamic Environment (X3)	X3.1	0.820	0.667	0.752	0.858
	X3.2	0.817			
	X3.3	0.814			
Supply Chain Agility (Y)	Y.1	0.701	0.614	0.894	0.917
	Y.2	0.775			
	Y.3	0.838			
	Y.4	0.849			
	Y.5	0.709			
	Y.6	0.787			
	Y.7	0.814			

The measurement constructs for process integration, supply flexibility, dynamic environment, and supply chain agility exhibit strong reliability and validity based on the given data. The factor loadings for all constructs are above the 0.7 threshold, indicating good indicator reliability. The AVE values are all above 0.5, suggesting sufficient convergent validity. High values of Cronbach's alpha and Composite Reliability further confirm the internal consistency and reliability of the constructs. Overall, the constructs used in this study are robust, providing

a reliable and valid basis for the empirical analysis of the relationships between process integration, supply flexibility, dynamic environment, and supply chain agility within the food and beverage industry.

### 4.3 Hypothesis

**Table 3: Hypothesis Testing**

Hypothesis	Path	T-Statistics	P-Values	Decision	Effects
H1	Process Integration (X1) → Supply Flexibility (X2)	6.136	0.000	Support	Direct
H2	Supply Flexibility (X2) → Supply Chain Agility (Y)	1.930	0.054	Unsupported	Direct
H3	Process Integration (X1) → Supply Chain Agility (Y)	2.533	0.012	Support	Direct
H4	Process Integration (X1) → Dynamic Environment (X3) → Supply Flexibility (X2)	1.559	0.120	Unsupported	Indirect
H5	Process Integration (X1) → Dynamic Environment (X3) → Supply Chain Agility (Y)	2.066	0.039	Support	Indirect
H6	Supply Flexibility (X2) → Dynamic Environment (X3) → Supply Chain Agility (Y)	5.327	0.000	Support	Indirect
H7	Process Integration (X1) → Supply Flexibility (X2) → Supply Chain Agility (Y)	1.749	0.081	Unsupported	Indirect

#### 4.3.1 Hypotheses Testing Result

Table 3 presents the results of hypothesis testing. Hypotheses 1 and 3 received significant support: hypothesis 1 (T-statistic = 6.136, p-value = 0.000) and hypothesis 3 (T-statistic = 2.533, p-value = 0.012). These findings show that process integration enhances both supply flexibility and supply chain agility. However, hypothesis 2 did not receive support (T-statistic = 1.930, p-value = 0.054), indicating that supply flexibility alone does not significantly impact supply chain agility. These insights deepen our understanding of the dynamics between process integration, supply chain flexibility, and agility, enriching the discourse on supply chain management and adaptability.

The moderation analysis of variables in this study yielded intriguing findings. Hypothesis 4, which posits that a dynamic environment moderates the relationship between process integration and supply flexibility, was not supported (T-statistic = 1.559, p-value = 0.120). This indicates no significant influence of a dynamic environment on the relationship between process integration and supply flexibility. Hypothesis 5, linking process integration with supply chain agility through the dynamic environment, was supported (T-statistic = 2.066, p-value = 0.039). This suggests that process integration significantly impacts supply chain agility in a dynamic environment. Hypothesis 6, stating that supply flexibility affects supply chain agility through the dynamic environment, was also supported (T-statistic = 5.327, p-value = 0.000). This indicates that supply flexibility significantly influences supply chain agility when moderated by a dynamic environment. The result of hypothesis 7 indicates no significant

impact of supply flexibility in mediating the relationship between process integration (T-statistic = 1.749, p-value = 0.081).

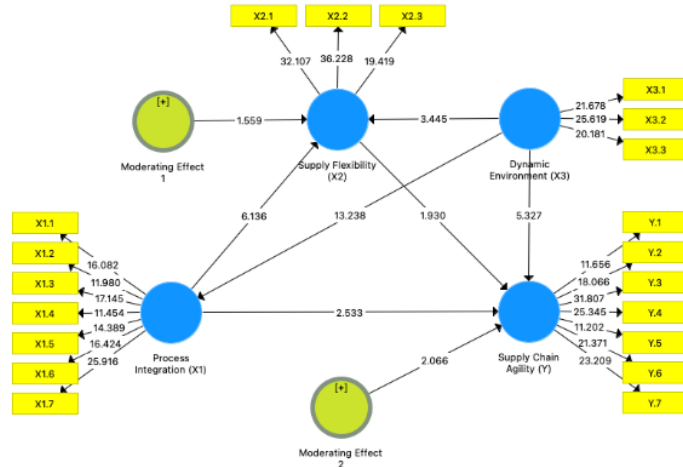


Figure 2: Inner Model Result

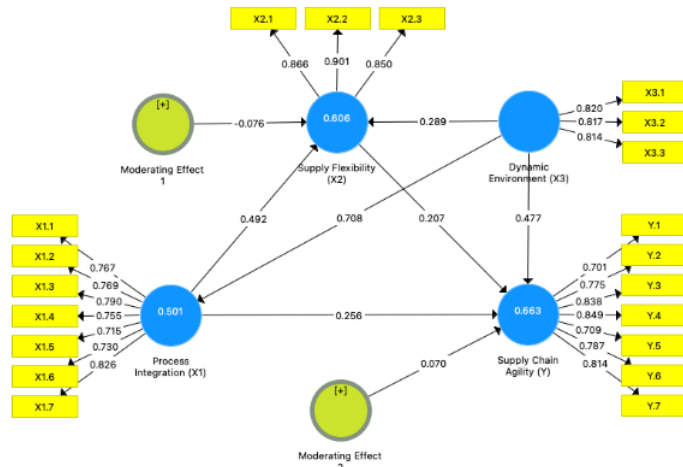


Figure 3: Outer Model Result

## 5. Discussion

Process integration is pivotal in advancing supply flexibility, which is essential for companies to cope with uncertainty and gain a competitive edge (Irfan et al., 2019). Process integration within the supply chain can improve agility, ultimately having a positive impact on a company's business performance (Haq & Aslam, 2022). Moreover, earlier studies have shown that supply flexibility is affected by various dimensions, including market-oriented and network-oriented perspectives, with network configuration flexibility being particularly important for superior performance and customer value creation (Chin et al., 2008). Additionally, the interrelationship between flexibility dimensions depends on supply chain complexity, emphasizing the necessity of considering the vertical complexity of the supply chain structure when implementing flexibility strategies. Overall, leveraging process integration and supply flexibility can help organizations adapt to dynamic market conditions and achieve sustainable competitive advantages. These findings align with the results of the first hypothesis test, which indicates a favorable relationship between process integration and supply flexibility. These findings

strengthen the position that process integration supports supply flexibility to achieve competitive advantage.

The relationship between supply flexibility and supply chain agility is supported by various research papers. Studies emphasize the impact of supply flexibility on supply chain agility, which consequently improves company performance across different industries (Darmawan et al., 2023). In the context of the food industry, supply flexibility has a varying impact on supply chain agility in developing countries. This phenomenon arises due to the lack of system integration between suppliers and manufacturers, leading to potential bias between demand and supply (Chin et al., 2008). In some literature, supply flexibility is highlighted as a crucial strategy for strengthening the relationship between supply chain collaboration and agility, enabling companies to be more responsive to market uncertainties and changing customer demands (Mukhsin et al., 2022). This is supported by the results of the second hypothesis test, which indicates a positive but not significant relationship between supply flexibility and supply chain agility. These findings underscore the need for process integration between the two. Collectively, these findings highlight the significance of supply flexibility in driving supply chain agility and overall organizational performance.

The role of process integration is crucial in enhancing supply chain agility, as highlighted in various research papers (Mukhsin et al., 2022). Additionally, Mate (2022) emphasizes the importance of coordinated supply metrics, supplier collaboration, and information sharing within organizations to enhance supply chain agility. Furthermore, Irfan et al. (2019) discusses how process integration impacts supply chain agility through supply flexibility and product-related complexity, ultimately affecting company business performance. These findings are reinforced by the results of the third hypothesis test, indicating a positive and significant relationship between process integration and supply chain agility in the context of the food industry in developing countries. Collectively, these findings demonstrate that process integration serves as a critical factor in driving supply chain agility, leading to improved operational performance and responsiveness to dynamic market conditions.

Process integration is essential for improving supply flexibility, particularly in dynamic environments. Studies have shown that process integration positively affects supply chain agility, which subsequently enhances business performance (Lyu et al., 2022). Furthermore, the integration of business strategies and strategic flexibility is essential for supply chain coordination and performance, with structural factors such as connectivity and formalization moderating the relationship between external uncertainty, business strategy integration, and strategic flexibility (Irfan et al., 2019). This is reinforced by the results of the fourth hypothesis test, indicating that process integration does not have a substantial effect on supply flexibility moderated by dynamic environments. This phenomenon aligns with the conditions of the food industry in developing countries, which still experience significant environmental dynamics amid uncertainty. This condition differs from companies in developed countries, which have more certainty and business support. Furthermore, the integration of supply chain information, especially through technological systems, facilitates information sharing and strengthens ambidextrous supply chain processes. Network capabilities also moderate this dynamic, influencing the overall relationship (Sessu et al., 2020). Collectively, these findings emphasize the importance of process integration in driving supply flexibility, especially in dynamic environmental conditions.

Process integration plays a crucial role in enhancing supply chain agility, particularly in dynamic environments. Research emphasizes that supply flexibility moderates the effect of



process integration on supply chain agility, ultimately affecting company business performance (Chen & Xiao, 2023; Lyu et al., 2022). Moreover, environmental dynamism positively impacts supply chain integration, with internal integration acting as a complete mediator in the connection between environmental hostility and the integration processes involving customers and suppliers. (Lyu et al., 2022). This is reinforced by the results of the fifth hypothesis test, indicating that process integration positively affects supply chain agility moderated by dynamic environments. Additionally, hyper-agile supply chains are highlighted as essential capabilities for organizations to navigate sudden disruptions, such as the COVID-19 pandemic, with hyper-agile supply chains being shaped by factors such as data analytics capabilities, market orientation, and supply chain integration (Raj et al., 2023; Sessu et al., 2020). Therefore, in dynamic environments, fostering process integration within supply chains is essential for achieving agility and effectively responding to environmental changes and disruptions.

Supply flexibility plays a crucial role in moderating the impact of dynamic environments on attaining supply chain agility. Research emphasizes that supply flexibility and agility are influenced by factors such as environmental turbulence, supply chain synergy, and strategic flexibility (Raj et al., 2023; Sessu et al., 2020). Developing a flexible supply chain, backed by dynamic capabilities, enables organizations to respond efficiently to market volatility and disturbances, as observed during the COVID-19 pandemic (Wang & Yang, 2022). This is reinforced by the results of the sixth hypothesis test, indicating that supply flexibility and supply chain agility are positively moderated by dynamic environments. Additionally, integrating business strategies and developing strategic flexibility is vital for boosting both supply chain coordination and operational performance amidst environmental uncertainty (Sessu et al., 2020; Zhu & Zhang, 2022). Furthermore, building trust within the supply chain, facilitated by blockchain technology and digital leadership, is essential for enhancing supply flexibility and adapting to changing market demands (Raj et al., 2023). In essence, a flexible supply chain, supported by dynamic capabilities and strategic alignment, is key to navigating dynamic environments and achieving supply chain agility.

The relationship between process integration and supply chain agility is complex, with supply flexibility often posited as a key mediating factor. Process integration significantly enhances supply flexibility by fostering better coordination, seamless information flow, and streamlined operations across the supply chain (Jum'a & Bushnaq, 2024). This increased flexibility theoretically contributes to supply chain agility by allowing companies to respond more quickly and effectively to changes in demand and supply conditions (Bai, 2024). However, the mediation effect of supply flexibility may be influenced by various factors specific to the industry and regional context. In developing countries, where challenges such as infrastructure limitations, regulatory hurdles, and market volatility are prevalent, the expected benefits of supply flexibility in enhancing agility might be attenuated (Irfan et al., 2019). These external factors can overshadow the internal improvements brought about by process integration, leading to a situation where supply flexibility does not significantly mediate the relationship between process integration and supply chain agility.

## 6. Conclusion

In the dynamic business environment of today, particularly within the food and beverage industry, the importance of process integration and supply flexibility is paramount. This study confirms that process integration significantly enhances supply flexibility, underscoring the need for internal collaboration and strategic alignment within organizations. Despite the direct relationship between supply flexibility and supply chain agility not being statistically

significant, process integration was found to have a significant positive impact on supply chain agility. This suggests that while flexibility alone may not directly drive agility, integrated processes are essential for achieving it. Moreover, the study highlights the critical role of a dynamic environment in moderating the effects of process integration and supply flexibility on supply chain agility. Although supply flexibility did not significantly mediate the relationship between process integration and supply chain agility, it remains vital within the broader context of a dynamic environment.

This emphasizes the importance of dynamic capabilities, such as sensing, communication, and coordination, in managing risks and navigating uncertainties in the market. Ultimately, this study provides valuable insights from Indonesia's food and beverage sector, emphasizing the need for organizations to integrate their processes and enhance supply flexibility to remain competitive and responsive to the ever-changing market conditions, thereby achieving sustained competitive advantages in the global marketplace.

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