

Uncertain Supply Chain Management

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Effect of strategic agility, innovation capability, and technology adoption through supply chain integration on the firm performance moderated by environmental turbulence in Indonesia's textile industry

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ABSTRACT

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Textile industry involves a lengthy process from upstream to downstream, making supply chain integration crucial for enhancing firm performance. This study explores various factors that can boost supply chain integration and company performance in Indonesia's textile sector, including strategic agility, innovation capability, and technology adoption. The research is grounded in resource-based-view and market-based-view theories, suggesting that companies can optimize their resources and collaborate effectively with supply chain partners to enhance industry performance. Additionally, the study considers environmental turbulence as a moderating variable. Utilizing a quantitative approach with judgmental sampling, the research collected data through a structured questionnaire, resulting in 270 valid responses. The data was analyzed using the partial least squares structural equation modeling (PLS-SEM) method with SmartPLS 4.0 software. Findings indicate that strategic agility, innovation capability, and technology adoption significantly influence firm performance through supply chain integration, while environmental turbulence notably moderates the relationship between innovation capability and supply chain integration on firm performance. The study recommends that textile companies prioritize agility, strategic innovation, and technology adoption to enhance their integration with supply chain partners. It underscores the critical role of supply chain integration in improving company performance and the impact of environmental turbulence as a moderating factor.

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1. Introduction

Supply chain integration is an important factor in the textile industry, which has a long process from upstream to downstream (Junejo et al., 2024). Supply chain integration creates better collaboration and improves communication and cooperation among various stakeholders in the supply chain, such as suppliers, manufacturers, and distributors (Shahzad et al., 2024). Supply chain integration is a strategic challenge that fluctuates on whether the integration of these parties can achieve goals such as long-term growth in company performance (Maestrini et al., 2018). The textile industry is a key sector in Indonesia, being labor-intensive, meeting clothing needs, generating foreign exchange, and driving economic growth. Indonesia is one of the largest textile-producing countries and the 12th largest textile exporter in the world (Saengchai et al., 2019). In 2022, Indonesia's textile sector generated \$14.41 billion in exports and \$13.02 billion in 2021. This underscores the need for skilled performance to support the industry, which faced GDP declines of -8.88% in 2020 and -4.08% in 2021. This indicates that the industry must improve its performance (Alif, 2022). The textile industry in Indonesia has experienced several environmental turbulences, such as economic restrictions during the covid-19 pandemic, the threat of recession, instability in oil prices after the Russia-Ukraine war, and a decline in export demand due to high inflation in destination countries. Textile raw materials in Indonesia still rely on imports from other countries whose value reaches 10.35 billion USD. High freight rates and delivery delays are major challenges for importing raw materials in Indonesia's textile industry. Lead times have increased from 14-15 days to 3-4 weeks due to port congestion and a shortage of container ships, raising costs and delaying both imports and exports.

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Indonesia's total fiber consumption will reach 1,858,102 tons in 2022, consisting of several types, including 40% polyester, 30% rayon, 28% cotton, and 2% others. (Textile Report in Indonesia by United States Department of Agriculture Report, 2022). The other challenge for the textile industry in Indonesia is high imports of ready-made clothing, making it difficult for local products to compete, weakening domestic production, and disrupting the supply chain network (Sarasi et al., 2023). This condition highlights the need for effective supply chain integration in Indonesia's textile industry, which spans from synthetic fiber production to finished apparel. Proper integration can mitigate uncertainties in the supply and demand of raw materials and finished products. Trihastuti et al. (2024) revealed that a sustainable supply chain can be achieved through integration in the textile industry in Indonesia. Suradi et al. (2020) also found that supply chain management had a significant effect on firm performance in the textile industry in Indonesia. Many recent studies emphasize the importance of supply chain integration in improving company performance (Harianto et al., 2024; Ralahallo et al., 2024; Chatha et al., 2024; Sundram et al., 2016; Aeknarajindawat & Chancharoen, 2019). Therefore, companies in the textile industry need to improve supply chain integration (Chatchawanchanchanakij et al., 2023). Companies are required to be more agile in responding to the challenges they face; therefore, they must adopt strategic agility (Dayioglu et al., 2024). Strategic agility is a company's ability to quickly adapt its strategy to changing market conditions and challenges, emphasizing flexibility, speed, innovation, and resilience. It helps organizations remain competitive in dynamic environments (Jasim et al., 2024). Many recent studies emphasize the importance of strategic agility in facing challenges and improving company performance (Marlapa et al., 2024; Liu et al., 2024; Luu, 2024). Indonesia's large textile market demands rapid product distribution to keep up with changing consumer tastes, making supply chain integration (SCI) essential for companies to achieve their goals (Zimmermann et al., 2020). Companies need to enhance efficiency in supply chain management to better connect partners in material transportation and improve information flow among integrated parties. (Sillanpää, 2015).

Textile companies can create high-value products but need to boost innovation, as success relies on their ability to innovate (Shin et al., 2015; AlTaweel & Al-Hawary, 2021). Innovation capability involves fostering an environment equipped with the resources, processes, and mindset required to consistently generate and execute new ideas that promote growth and success (Allammari et al., 2024). Innovation enables companies to tackle internal and external challenges, ensuring business continuity amid environmental changes (Yildiz & Aykanat, 2021; Wadho & Chaudhry, 2018; Setiawan et al., 2022). Many recent studies emphasize the importance of innovation capability to improve company performance in the textile industry (Celik & Uzuncarsili, 2023; Arshad et al., 2023). Consumers consider both the value and added advantages of a product compared to similar options. Innovation is crucial for product development and differentiation, whether for new or existing products. Innovation capabilities can produce high-quality products, improving company performance (Tian et al., 2021). Innovation capability includes external factors from suppliers and consumers, enhancing supply chain integration within a company (Iddris, 2016; Zimmermann et al., 2020; Liao & Li, 2018). Several previous studies have found that innovation capability influences the supply chain (Liao et al., 2021; Qiao et al., 2021; Octavia et al., 2020; Fianko et al., 2022). Innovation and intense global competition drive the industry to be agile; failure to do so can lead to a decline in company performance (Suradi et al., 2020; Haider & Kayani, 2020; Kurniawan et al., 2020; Lyn Chan & Muthuveloo, 2021). Achieving to this demands strategic agility, allowing the company to swiftly adapt and drive change while maintaining flexibility and focus, requiring continuous effort and hard work (Al-Nattar & Alazzawi, 2020; Lyn Chan & Muthuveloo, 2022; Yildiz & Aykanat, 2021; Khaw & Teoh, 2023). The organization implements unique practices at all stages, necessitating agile management to quickly respond to changing consumer needs, government policies, and climate dynamics. Strategic agility enhances company performance and is vital for sustainability (Hijjawi & Al-shawabkeh, 2017). In the textile industry in Indonesia, Suradi et al. (2020) found that strategic agility had a significant effect on firm performance. Previous studies have revealed that strategic agility influences the supply chain (Suradi et al., 2020; Mavengere, 2013; Hussain et al., 2018; Yawson & Yamoah, 2022). Other research also found that strategic agility affects company performance (Khaw & Teoh, 2023; Sikora & Baranowska, 2022; Vrontis et al., 2022; Nurjaman et al., 2021). Technology adoption accelerates a company's effectiveness and efficiency. It is both an opportunity and a challenge in labour-intensive industries such as the textile industry in Indonesia (Nazeer et al., 2021; Cho, 2019). The benefits of adopting technology include: supporting company operational activities to be more efficient and faster, the existence of various applications that make reporting/business activities easier, allowing for faster presentation of information, as well as automating processes that are carried out manually by humans (Lucia-Palacios et al., 2014; Dalle et al., 2020; Dadoukis et al., 2021; Behera et al., 2015).

The textile industry in Indonesia is one of the industrial sectors most ready to implement technology industry 4.0. The ministry of industry has released the Indonesia industry 4.0 Readiness Index (INDI 4.0). This index is to measure industry readiness to implement industry 4.0. This index consists of level 0 (not ready), level 1 (initial readiness), level 2 (medium readiness), level 3 (mature readiness), and level 4 (already implemented). INDI 4.0 assesses industrial readiness based on five pillars, namely management and organization, people and culture, products and services, technology and factory operations. This index is one of the Ministry of Industry's strategic efforts to accelerate the implementation of industry 4.0 in Indonesia. The five priority sectors are already approaching level 2 and level 3. The readiest sectors are the textile industry at level 2.51; food and drink 2.47; chemistry 2.31; electronics 1.84; and automotive 1.72 (Kementerian Perindustrian, 2021). Previous studies have examined firm performance across various industries and countries. In Indonesia's textile industry, firm performance is crucial for business sustainability and achieving company goals (Saengchai et al., 2019; Suradi et al., 2020; Aeknarajindawat & Chancharoen, 2019; Purwanto, 2019). In several countries, firm performance in the textile industry is vital for overall business success (Wadho & Chaudhry, 2018; Shahi et al., 2021; Zia-Ur-Rehman et al., 2019; Nazeer et al., 2021; Iqbal et al.,

2022; Zhong & Lyu, 2022; Cho, 2019). Supply chain integration factors also influence firm performance. Supply chain integration positively affects firm performance (Cho, 2019; Nazeer et al., 2021). The board of directors must oversee supply chain activities to enhance company performance (Shahi et al., 2020; Zhong & Lyu, 2022). Companies must consistently enhance their innovation capabilities (Jalil et al., 2021; Raharja & Rivani, 2022). Innovation capability will strengthen supply chain integration (Iddris et al., 2014) and firm performance (Nazeer et al., 2018; Zia-Ur-Rehman et al., 2019). Companies must implement strategic agility to make activities more agile for effective and efficient results. (Khaw & Teoh, 2023; Sikora & Baranowska, 2022; Vrontis et al., 2022). Strategic agility will strengthen supply chain integration (Hussain et al., 2018; Yawson & Yamoah, 2022). A study in the textile industry shows that strategic agility improves company performance (Suradi et al., 2020). Technology adoption increases process efficiency in the supply chain and company performance. Several previous studies found that technology adoption affected the supply chain (Chowdhury et al., 2022; Han & Rani, 2022; Jabbour et al., 2012; Adel & Younis, 2021; Bai & Song, 2022). And technology adoption affected company performance (Evangelista et al., 2012; Lucia-Palacios et al., 2014; Dalle et al., 2020; Mandal & Dubey., 2020; Dadoukis et al., 2021).

Through supply chain integration it will improve company performance. Several previous studies found that supply chain integration affected the firm performance (Agyei-Owusu et al., 2022; Tian et al., 2021). Finally, this research looks at the influence of these variables amidst environmental turbulence. Previous research revealed there is a moderating relationship of environmental turbulence, between strategic agility and firm performance (Reed, 2020). Between innovation capability and firm performance (Gyedu et al., 2021; Turulja & Bajgoric, 2018; Tsai & Yang, 2014). Between technology adoption and firm performance (Hung & Chou, 2013). Between supply chain integration and firm performance (Chatterjee & Chaudhuri, 2021; Silvestre, 2015). This research will emphasize supply chain integration in industries with long process flows and explore strategic agility, innovation capability, and technology adoption to enhance performance in the textile industry.

2. Review of the literature and research hypotheses

2.1 Relationship between Strategic Agility and Supply Chain Integration

Strategic agility comprises strategic sensitivity, strategic response, and collective capabilities. Strategic sensitivity involves actively gathering and utilizing actionable data. Strategic response entails collaborating with customers and business partners to swiftly adjust resources and processes. Collective capabilities refer to an organization's capacity to leverage the synergy among its resources (Mavengere, 2013). By swiftly adapting to evolving customer preferences, strategic agility enhances communication with suppliers to capitalize on reduced costs, improved quality, and enhanced delivery times. In a competitive landscape marked by rapidly changing customer preferences, companies face challenges that require them to respond promptly. Strategic agility enables organizations to react swiftly and effectively in such competitive environments (Clauss et al., 2021). Through strategic agility, companies can promptly react to market fluctuations and serve as the linchpin in aligning suppliers with customers. In the textile industry, when there are shifts in downstream market sectors, all components of the supply chain must adjust from upstream (Suradi et al., 2020). Strategic agility enables swift responses to these shifts and facilitates enhanced external integration to optimize the supply chain. The theory that strategic agility positively correlates with supply chain integration is affirmed by studies conducted by (Hussain et al., 2018) and (Yawson & Yamoah, 2022). Effective implementation of strategic agility by a company enhances the integration of the supply chain, linking suppliers to customers seamlessly. The hypotheses that will be tested regarding strategic agility and supply chain integration are:

Hypothesis 1. *Strategic Agility has a positive effect on Supply Chain Integration.*

2.2 Relationship between Innovation Capability and Supply Chain Integration

Innovation capability encompasses multiple dimensions, including both product and process innovation. Product innovation involves introducing new offerings that encompass a variety of creative or enhanced products and services (Altaweel & Al-Hawary, 2021). Iddris (2016) examined innovation capabilities, aiming to explore the connection between innovation capability and supply chain agility, emphasizing integration that fosters trust development. As the global landscape increasingly adopts digital business models and technology, the supply chain industry necessitates innovative initiatives for swift integration. Innovation capability refers to a company's capacity to integrate novel elements into processes to enhance value, particularly through supply chain integration (Paul & Zhou, 2017). The ability of a company to innovate its processes significantly affects both suppliers and customers. Companies continually discover how innovative processes can meet customer demands, necessitating supplier involvement in their execution. Therefore, there is an ongoing need for creative processes in integrating supply chains (Qiao et al., 2021). The proposition that there is a positive correlation between innovation capability and supply chain integration is also substantiated by (Iddris et al., 2014; Isfianadewi et al., 2019; Nur, 2019). The expectation is that innovation capabilities will enable and enhance supply chain integration. The hypotheses that will be tested regarding innovation capability and supply chain integration are:

Hypothesis 2. *Innovation Capability has a positive effect on Supply Chain Integration.*

2.3 Relationship Between Technology Adoption and Supply Chain Integration

Technology Internet of Things enables increased integration in the manufacturing process between suppliers and customers through the internet. This improved integration can help the flow of information flow faster, resulting in increased efficiency and ultimately enabling companies to respond to customer requests promptly (Tiwari, 2021). Big Data Analytics technology learns what needs are and what obstacles are faced by customers and suppliers so that it can predict things in the future. Resource scarcity and other problems can be predicted and by adopting BDA technology, companies can find the fastest solutions to create an integration that maximizes the potential of suppliers, companies and customers (Chiu & Lin, 2022). The adoption of industry 4.0 technology not only integrates technology with machines, but also creates integration between users from suppliers, companies and customers who are connected in real-time so that the integration process is created faster and more accurately (Jabbour et al., 2012). Chatchawanchanchanakij et al. (2023) found that technology adoption has an impact on sustainable supply chains. The hypothesis of a positive relationship between technology adoption and supply chain integration is also supported by (Chauhan et al., 2021; Chatterjee et al., 2022; Salamah et al., 2023). Technology adoption is hoped to facilitate supply chain integration and ultimately improve company performance. The hypotheses that will be tested regarding technology adoption and supply chain integration are:

Hypothesis 3. *Technology Adoption has a positive effect on Supply Chain Integration.*

2.4 Relationship Between Strategic agility and Firm Performance

Strategic agility enables companies to promptly and efficiently anticipate or react to market changes. As a result, it is anticipated to enhance overall corporate performance. Strong strategic agility enables companies to adjust products or services to better meet customer requirements. Rapid response to customer needs is a key indicator of good corporate performance, as it enhances customer satisfaction (Ahmad, 2022). Achieving strategic agility involves ongoing assessment of internal and external environmental factors, swift gathering and utilization of information, and rapid adaptation to market changes. When a business achieves strategic agility, it can enhance overall company performance (Kale et al., 2019). Research conducted in the textile industry demonstrates that strategic agility enhances the performance of companies (Suradi et al., 2020). Similar results were documented by (Kale et al., 2019) and (AlTaweel & Al-Hawary, 2021). The hypotheses that will be tested regarding strategic agility and firm performance are:

Hypothesis 4. *Strategic Agility has a positive effect on Firm Performance.*

2.5 Relationship Between Innovation Capability and Firm Performance

Innovation capability empowers companies to continuously explore and generate innovations, as innovation is crucial for enhancing company performance and gaining a competitive edge. By persistently innovating, companies can enhance performance through the development of new ideas, processes, and products, or by refining existing business operations (Ferreira et al., 2018). A critical phase in the innovation process involves converting input into output. It is believed that innovative companies employ various strategies to accomplish their objectives (Wadho & Chaudhry, 2018). A company's capacity to innovate by developing new products may necessitate novel production methods, while introducing these new products often demands fresh marketing strategies or processes. Overall, research indicates that increased utilization of innovation strategies correlates with improved company performance (Wadho & Chaudhry, 2018). Research conducted within the textile industry demonstrates that innovation capabilities enhance company performance (Nazeer et al., 2021; Zia-Ur-Rehman et al., 2019). Similar conclusions were reported by (Zimmermann et al., 2020) and (Ferreira et al., 2018). There is optimism that innovation capability will enhance company performance. The hypotheses that will be tested regarding innovation capability and firm performance are:

Hypothesis 5. *Innovation Capability has a positive effect on Firm Performance.*

2.6 Relationship Between Technology Adoption and Firm Performance

Technology Adoption can help make product development decisions, price optimisation and forecasting, satisfying customer demands in a better way and improving company performance (Lin et al., 2019). Technology allows companies to reconfigure production resources for the manufacture of customized products efficiently and with flexibility. Finally, through processing and shaping, technology adoption can help to make production-related decisions that can improve operational efficiency, reduce costs and increase company profits (Diaz-Chao et al., 2021). A study in the textile industry shows that technology adoption improves company performance (Nazeer et al., 2021; Cho, 2019). Studies in other industries also find that technology adoption can improve company performance (Bhagat et al., 2022; Kumar & Bhatia, 2021; Arifin et al., 2016; Lin et al., 2019). The hypotheses that will be tested regarding technology adoption and firm performance are:

Hypothesis 6. *Technology Adoption has a positive effect on Firm Performance.*

2.7 Relationship Between Supply Chain Integration and Firm Performance

Supply chain integration comprises several dimensions, including customer, supplier, and internal integration. It involves sharing demand information to enhance manufacturers' understanding and forecasting of customer needs, engaging in collaborative product design with customers to deliver higher quality products at reduced costs, and increasing flexibility in responding to customer demand (Cui et al., 2023). Supply chain integration represents a sophisticated process of collaboration among the company, suppliers, and buyers. When effectively managed, it can enhance operational efficiency, boost company profits, and ensure satisfaction for all involved parties (Agyei-Owusu et al., 2022). Firm performance encompasses various aspects including profitability, growth, and customer satisfaction. Profitability performance measures the company's ability to generate profits from its operations, while growth performance evaluates its capacity to expand. Customer satisfaction gauges how effectively the company interacts with its customers. Tian et al (2021) discovered that effective supply chain integration enhances company performance, enabling companies to make swift decisions in competitive environments. Similar results were also observed by Suradi et al. (2020) and Iddris et al. (2014). The hypotheses that will be tested regarding supply chain integration and firm performance are:

Hypothesis 7. *Supply Chain Integration has a positive effect on Firm Performance.*

2.8 Relationship Between Environmental Turbulence as a moderator variable

Environmental turbulence is a dynamic, unpredictable, evolving, fluctuating environment characterized by uncertainty and instability. Environmental turbulence challenges existing strategies, requiring adaptation of strategies and strategic planning processes if companies are to survive (Wilden & Gudergan, 2015). Strategic agility may not be as important in stable environments as it is in environmentally volatile environments (Reed, 2020). The relationship between innovation and a company's business performance depends on the external environment. Greater business performance can be achieved by matching innovation to markets by adapting to technological changes and environmental shocks (Gyedu et al., 2021). It is important to realize that environmental shocks will occur in the future. However, by adopting technology, companies can respond quickly and precisely to environmental crises. This will enable the company to maintain its performance and be more flexible when environmental turbulence occurs (Chatterjee & Chaudhuri, 2021). Environmental turbulence forces every party in the supply chain, including suppliers and customers, to adapt to new demands. This can weaken or strengthen the integration created because it is related to company performance. Therefore, environmental turbulence can influence the relationship between supply chain integration and company performance (Silvestre, 2015). The hypotheses that will be tested regarding environmental turbulence as a moderator variable are:

Hypothesis 8. *Strategic agility positively affects firm performance, moderated by environmental turbulence.*

Hypothesis 9. *Innovation capability positively affects firm performance, moderated by environmental turbulence.*

Hypothesis 10. *Technology adoption positively affects firm performance, moderated by environmental turbulence.*

Hypothesis 11. *Supply chain integration positively affects firm performance, moderated by environmental turbulence.*

Based on the explanation of the relationships between variables in this study, we developed a research model, as presented in Fig. 1.

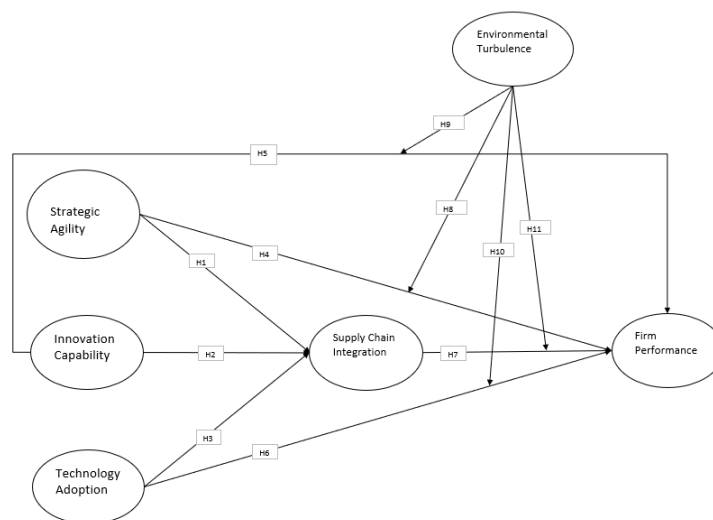


Fig. 1. Research Model

3. Research Methodology

Using a quantitative study approach, the research investigated the effect of strategic agility, innovation capability, technology adoption and supply chain integration on the firm performance moderated by environmental turbulence.

3.1 Sample Data Collection

Data was gathered from textile companies in Indonesia between April and June 2024. Respondents were chosen through judgmental sampling, specifically targeting individuals holding managerial, directorial, or commissioner roles within their companies. This selection criteria aimed to ensure that respondents had insights into enhancing company performance and the capability to mobilize resources effectively. Java Island was selected as the study's location due to its concentration of textile companies, which is the highest among all islands in Indonesia (Kementrian perindustrian, 2023). Data were gathered through online distribution of a questionnaire via email and WhatsApp. According to Hair et al. (2011), the sample size in the study can be estimated by multiplying the number of indicators by 5 to 10. This study included 54 research indicators, and a total of 270 questionnaires were analyzed. The questionnaire comprised two sections. The initial section requested respondents' demographic information, whereas the subsequent section evaluated respondents' agreement with statements that measured variables in the study.

3.2 Scale Development

Measurement items for the key constructs were adapted from existing literature. Strategic agility, a multifaceted concept with three dimensions and nine components, was assessed using three items for each dimension sourced from (Maverange, 2013; Uddin et al., 2023; ALTaweel & Al-Hawary, 2021). Innovation capability is similarly a multifaceted concept with two dimensions and six components. Each dimension was evaluated using three items adapted from (Altawel & Al-Hawary, 2021; Turulja & Bajgoric, 2018). Technology adoption is a multidimensional construct with three dimensions and twelve constructs. Three dimensions was measured by twelve items adopted from (Castelo-Branco et al., 2022; Kaddumi et al., 2023; Mikalef et al., 2019; Evangelista et al., 2012). Supply chain integration is a multidimensional concept, comprising three dimensions and nine components. Each dimension was assessed using three items sourced from (Cui et al., 2023). Environmental turbulence is a multidimensional construct with two dimensions and eight construct, Each dimension was measured by four items adopted from (Huang et al., 2022; Yasmeen et al., 2020; Wilden & Gudergan, 2015; Turulja & Bajgoric, 2018; Bashir et al., 2023). Firm performance is a complex construct that includes three dimensions and ten components. Each dimension was assessed using a selection of three to four items taken from (Mikalef et al., 2019; Selvam et al., 2016). All items were measured using a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree).

3.3 Model Measurement

The data were analyzed using partial least squares structural equation modeling (PLS-SEM) to concurrently assess the proposed relationships in the study. PLS-SEM allows for explicit examination of relationships among multiple dependent and independent variables, making it suitable for analyzing data within a complex research framework. The data was examined using Smartpls 4.0. The outer and inner models are two stages of the instrument examination. The criteria for the outer model examination are Outer Loading>0.7, Average Variance Extracted (AVE)>0.5, Composite Reliability (Pc)>0.7, Cronbach's Alpha>0.6, and Discriminant Validity (Hair et al., 2011).

4. Results

4.1 Profile of Respondents

Table 1 presents the main characteristics of the survey participants.

Table 1
Demographic characteristics of the respondents

Characteristics	Frequency	Percentage	Characteristics	Frequency	Percentage	Characteristics	Frequency	Percentage
Gender:			Length of work:			Employees:		
Male	169	62.6	1-5 years	56	20.7	0-100	79	29.3
Female	101	37.4	5-10 years	52	19.2	101-500	95	35.2
			> 10 years	162	60.1	More than 500	96	35.5
Age:			Industrial type:			Location:		
23-35	127	47.0	Fibre	17	6.3	Banten	72	26.7
36-45	78	29.0	Yarn	42	15.5	Jakarta	18	6.7
46-55	46	17.0	Fabric	119	44.1	Jawa Barat	154	57.0
More than 55	19	7.0	Others	92	34.1	Jawa Tengah	10	3.6
						DI Yogyakarta	5	1.9
						Jawa Timur	11	4.1
Education:			Position:					
High school	14	5.2	Commissioner	16	5.9			
Bachelor Degree	208	77.0	Director	42	15.6			
Master Degree	48	17.8	Manager	212	78.5			

The findings indicate a slightly higher percentage of male respondents compared to female respondents. Over 75% of respondents fall within the age range of 23 to 45 years. A majority of respondents, more than 60%, hold bachelor's degrees and work in managerial positions with over 10 years of work experience. The majority of textile companies are located in West Java (57%), employing more than 500 individuals in 35% of cases. Many companies operate within the fabric sector (44%) or other segments of the textile industry (34%).

4.2 Measurement Model

Before proceeding to analyze the structural model, this study assessed the validity and reliability of the measurement items. An indicator is deemed valid if it exhibits a factor loading and Average Variance Extracted (AVE) value exceeding 0.5 (Chin & Todd, 1995). In this study, reliability was assessed using Cronbach's alpha and composite reliability. According to Chin and Todd (1995), a variable is deemed reliable if its Cronbach's alpha or composite reliability reaches at least 0.7. Table II details the results of descriptive statistical analysis as well as the findings from validity and reliability assessments.

Table 2
Reliability and validity test

Variable	Dimension	Construct and items	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE	Remark
Strategic Agility	Strategic sensitivity	SA1	0,949	0,931	0,956	0,878	Valid & Reliable
		SA2	0,925				
		SA3	0,937				
	Strategic Response	SA4	0,939	0,925	0,953	0,870	Valid & Reliable
		SA5	0,916				
		SA6	0,943				
	Collective capabilities	SA7	0,943	0,909	0,943	0,846	Valid & Reliable
		SA8	0,895				
		SA9	0,921				
Innovation Capability	Product innovation	IC1	0,937	0,912	0,945	0,850	Valid & Reliable
		IC2	0,913				
		IC3	0,917				
	Process innovation	IC4	0,926	0,907	0,942	0,844	Valid & Reliable
		IC5	0,916				
		IC6	0,914				
Technology Adoption	Smart Factory	ITA1	0,925	0,908	0,942	0,845	Valid & Reliable
		ITA2	0,907				
		ITA3	0,926				
	Enablers	ITA4	0,885	0,880	0,926	0,807	Valid & Reliable
		ITA5	0,909				
		ITA6	0,902				
	IT Strategy	ITA7	0,838	0,943	0,954	0,778	Valid & Reliable
		ITA8	0,899				
		ITA9	0,896				
		ITA10	0,875				
		ITA11	0,884				
		ITA12	0,898				
Supply Chain Integration	Customer integration	SCI1	0,896	0,878	0,925	0,804	Valid & Reliable
		SCI2	0,904				
		SCI3	0,903				
	Supplier integration	SCI4	0,902	0,898	0,937	0,831	Valid & Reliable
		SCI5	0,912				
		SCI6	0,921				
	Internal integration	SCI7	0,901	0,888	0,930	0,817	Valid & Reliable
		SCI8	0,914				
		SCI11	0,896				
Environmental Turbulence	Technological Turbulence	ET1	0,875	0,926	0,948	0,819	Valid & Reliable
		ET2	0,931				
		ET3	0,910				
		ET4	0,904				
	Market Turbulence	ET5	0,906	0,926	0,948	0,819	Valid & Reliable
		ET6	0,913				
		ET7	0,915				
		ET8	0,887				
Firm Performance	Profitability performance	FP1	0,904	0,929	0,949	0,824	Valid & Reliable
		FP2	0,917				
		FP3	0,913				
		FP4	0,898				
	Growth performance	FP5	0,905	0,899	0,937	0,832	Valid & Reliable
		FP6	0,912				
		FP7	0,920				
	Customer Satisfaction	FP8	0,899	0,878	0,925	0,804	Valid & Reliable
		FP9	0,879				
		FP10	0,913				

Based on the validity assessment, all items exhibited factor loadings ranging from 0.838 to 0.949, with the Average Variance Extracted (AVE) values for all variables falling between 0.778 and 0.878. Composite reliability ranged from 0.925 to 0.956 across all variables. In the reliability analysis, all variables demonstrated composite reliability scores exceeding 0.7, and in the validity examination, all variables had AVE values above 0.5. Consequently, it can be affirmed that all items were both valid and reliable.

4.3 Hypothesis Testing

As presented in Table III, all relationships among strategic agility, innovation capability, technology adoption, supply chain integration, and firm performance were significant. Environmental turbulence moderated innovation capability and supply chain integration to firm performance. Environmental turbulence not moderated strategic agility and technology adoption to form performance. The path diagram is presented in Fig. 2.

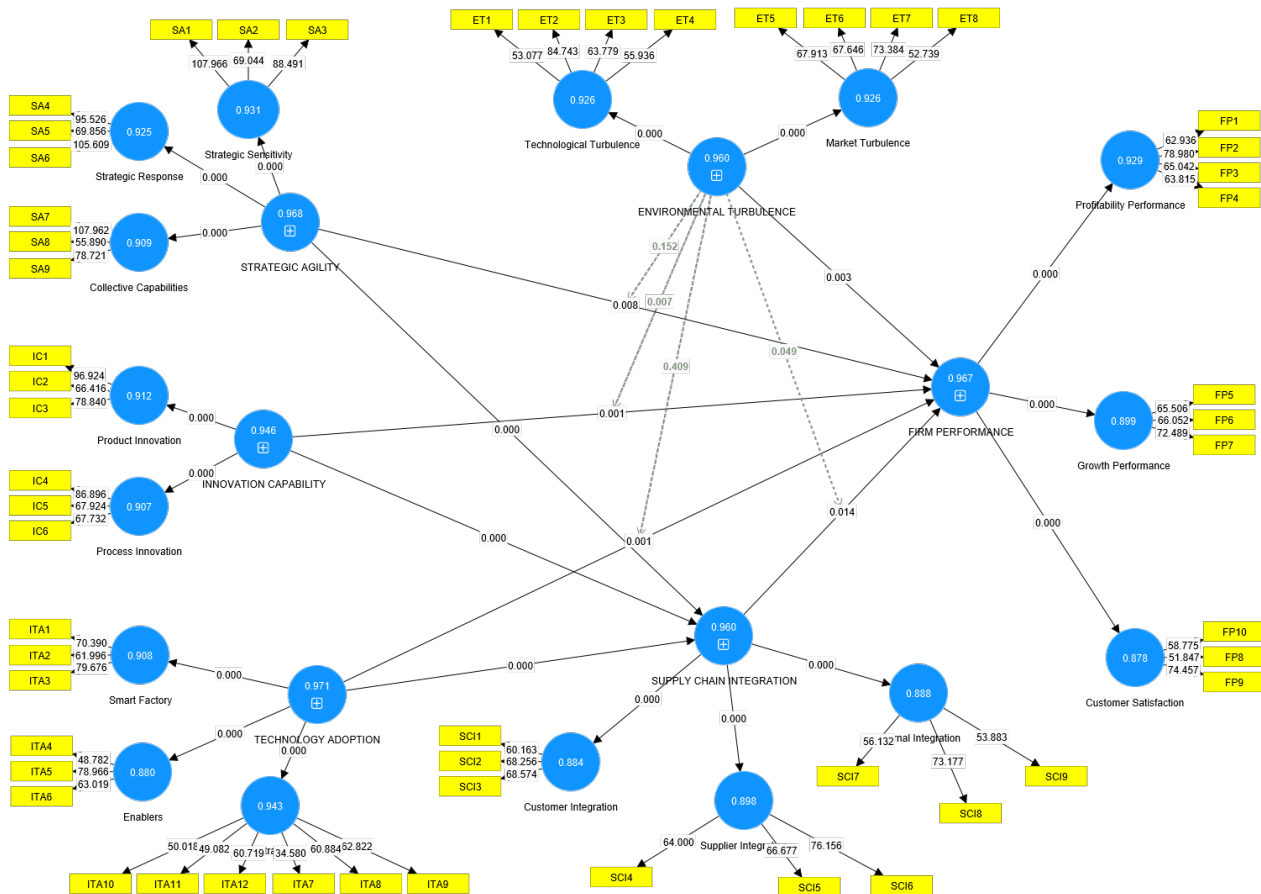


Fig. 2. Path Coefficient Analysis

Table 3
Summary of statistical hypothesis test

Hypothesis	Path coefficient	t-statistics	p-values	Remark
Strategic Agility → Supply Chain Integration	0.341	3.943	0.000	Supported
Innovation Capability → Supply Chain Integration	0.309	5.077	0.000	Supported
Technology Adoption → Supply Chain Integration	-0.331	3.978	0.000	Supported
Strategic Agility → Firm Performance	0.179	2.419	0.008	Supported
Innovation Capability → Firm Performance	0.180	3.155	0.001	Supported
Technology Adoption → Firm Performance	-0.225	3.283	0.001	Supported
Supply Chain Integration → Firm Performance	0.139	2.915	0.014	Supported
Environmental Turbulence moderated SA → FP	-0.059	1.031	0.152	Rejected
Environmental Turbulence moderated IC → FP	-0.129	2.471	0.007	Supported
Environmental Turbulence moderated TA → FP	0.015	0.231	0.409	Rejected
Environmental Turbulence moderated SCI → FP	0.151	1.964	0.049	Supported

Strategic agility showed a notable positive impact on supply chain integration ($\beta = 0.341, p < 0.05$), while innovation capability also exhibited a significant positive influence on supply chain integration ($\beta = 0.309, p < 0.05$). Conversely, technology adoption significantly negatively affected supply chain integration ($\beta = -0.331, p < 0.05$). Together, these three variables explained 88.8% of the variability in supply chain integration (adjusted $R^2 = 0.888$). Both strategic agility ($\beta = 0.179, p < 0.05$) and innovation capability ($\beta = 0.180, p < 0.05$) significantly positively influenced firm performance, as did supply

chain integration ($\beta = 0.139$, $p < 0.05$). In contrast, technology adoption significantly negatively impacted firm performance ($\beta = -0.225$, $p < 0.05$). These four variables collectively explained 90.5% of the variability in firm performance (adjusted $R^2 = 0.905$). Environmental turbulence significantly moderated the effects of innovation capability and supply chain integration on firm performance ($p < 0.05$). However, environmental turbulence did not significantly moderate the effects of strategic agility and technology adoption on firm performance ($p > 0.05$).

3 Discussion

This study aimed to evaluate 11 hypotheses outlined in section 2. Out of these, 9 hypotheses were supported while 2 were rejected. The positive and significant impact of strategic agility on supply chain integration aligns with findings from previous research by Hussain et al. (2018) and Yawson & Yamoah (2022). Information serves as a crucial driver of supply chain integration. Strategic agility facilitates quicker acquisition and utilization of necessary information. By anticipating future market and customer needs, strategic agility enables prompt integration with companies and suppliers. In the textile industry, rapid information flow and responsive actions from upstream to downstream contribute significantly to maintaining supply chain integration. The textile industry in Indonesia demonstrates a high level of agility in forecasting and responding to future information, as indicated by the strategic agility variable's high mean value (mean = 4.17 out of 5). Companies that excel in obtaining and leveraging information promptly can swiftly integrate it with customers and suppliers.

The impact of innovation capability on supply chain integration is positive and statistically significant, consistent with prior research such as that by (Iddris et al., 2014; Isfianadewi et al., 2019; Nur, 2019). Integration entails collaboration between entities. Innovation capability, characterized by its facets in the innovation process, enables companies to continuously seek more effective and efficient methods in the integration process. The incorporation of innovation into integrated operations enhances the pace of all related activities. In Indonesia's textile industry, there is a demonstrated ability to innovate within processes, reflected in the high mean value of the innovation capability variable (mean = 4.10 out of 5). Technology adoption significantly influences supply chain integration, consistent with earlier research by (Chauhan et al., 2021; Chatterjee et al., 2022; Salamah et al., 2023). And has significant influence on firm performance which supports previous studies by (Bhagat et al., 2022; Kumar & Bhatia, 2021; Arifin et al., 2016; Lin et al., 2019).

In a previous study technology adoption has a positive significant effect on supply chain integration and firm performance, new finding in this research technology adoption has a negative influence on supply chain integration and firm performance. This can happen because textile companies in Indonesia have not fully adopted existing technology, which can be seen from the low mean value of the technology adoption variable (mean = 1.90 of 5). Innovation capability, technology adoption, and strategic agility collectively account for 88.8% of the influence on supply chain integration. The textile industry in Indonesia has effectively implemented strategic agility and innovation capability, leading to substantial impacts and fostering robust integration within the textile supply chain in Indonesia, as evidenced by the high mean value of the supply chain integration variable (mean = 4.14 out of 5).

Strategic agility positively impacts firm performance, as supported by research findings from (Suradi et al., 2020; Kale et al., 2019; AlTaweel & Al-Hawary, 2021). Similarly, innovation capability enhances firm performance, consistent with studies by (Nazeer et al., 2021; Zia-Ur-Rehman et al., 2019; Zimmermann et al., 2020; Ferreira et al., 2018). Furthermore, supply chain integration positively influences firm performance, as indicated by research from (Tian et al., 2021; Suradi et al., 2020) and (Iddris et al., 2014). Effective company performance encompasses growth performance, profitability performance, and customer satisfaction. Supply chain integration reduces lead times for goods, shipping costs, and storage expenses, benefiting companies and enhancing customer satisfaction by aligning supply chains with customer needs.

The textile industry in Indonesia has effectively implemented the integration process. Companies can innovate within this process and swiftly gather market and customer insights. During periods of environmental turbulence, companies are prompted to enhance their innovation capabilities and integrate their supply chains more effectively. Innovation serves as a critical response to environmental challenges, requiring enhanced integration among all supply chain members (suppliers, companies, customers). Strategic agility and innovation capability contribute significantly to stronger supply chain integration, thereby impacting overall company performance. These factors, along with technology adoption, collectively account for 90.5% of company performance, ensuring the effective operation of textile companies in Indonesia. This is reflected in the high mean value of company performance (mean = 4.12 out of 5).

5. Conclusion

The main objectives of this study are to investigate the correlations among strategic agility, innovation capability, technology adoption, supply chain integration, environmental turbulence, and firm performance. From the hypothesis testing results, 9 out of 11 hypotheses were supported while 2 were rejected. Notably, the impacts of strategic agility, innovation capability, and technology adoption on firm performance are mediated through supply chain integration. Innovation capability plays a crucial role in integrating processes within the supply chain, enabling rapid acquisition of information essential for integration, facilitated by strategic agility's focus on anticipating future market and customer needs. Technology adoption significantly influences both supply chain integration and firm performance, emphasizing the necessity for comprehensive technological

adoption to prevent adverse relationships. Ultimately, supply chain integration reduces operational costs, enhances company profitability, and enhances customer satisfaction by aligning with current and future customer needs. Companies must maintain strategic agility to swiftly adapt to market and customer changes. During environmental turbulence, companies should bolster their innovation capability and enhance supply chain integration processes, leading to improved overall company performance.

This research provides implications for enhancing the performance of Indonesia's textile industry. It demonstrates that strategic agility and innovation play positive roles in connecting supply chain integration and firm performance. Companies should enhance strategic agility by carefully assessing present and future opportunities and challenges, which can inform responsive strategies. Additionally, prioritizing innovation capability is crucial for integrating innovation into the supply chain integration process effectively. Efficient supply chain operations significantly enhance firm performance, particularly in Indonesia's textile industry, which involves extensive upstream and downstream processes. This improvement ultimately leads to enhanced company performance. When adopting technology, companies must ensure thorough implementation to avoid any negative impact on company performance. Moreover, during environmental disruptions, textile companies should focus on enhancing innovation and integration across all supply chain segments.

This study validated the model linking strategic agility, innovation capability, technology adoption, supply chain integration, environmental turbulence, and firm performance through a survey conducted among textile companies in Indonesia. Previous studies have rarely explored technology adoption within the textile industry, especially in Indonesia. This research introduces novel insights, revealing a potential negative and significant relationship between technology adoption, supply chain integration, and company performance. Several limitations should be acknowledged when interpreting the findings of this study. Firstly, the data collection utilized a non-probability sampling technique and was confined to respondents from the Java Island region. This may constrain the generalizability of the results in explaining the performance of textile companies on a broader scale. Future studies could employ probability sampling and include companies from different islands or cities to enhance the robustness of the findings. Secondly, future research could extend this framework to diverse business sectors and research settings, such as automotive and agriculture industries, to further validate and refine the theoretical underpinnings.

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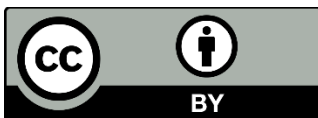
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