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Building competitive advantage through leadership competency, responsiveness, integration, and supply chain agility: Assessing the moderating role of supply chain digitalization

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A B S T R A C T

Indonesia's manufacturing industry is experiencing a weakening in performance: the PMI fell to 46.9 in June 2026, and the Logistics Performance Index ranking slumped to 61st out of 139 countries, signaling a decline in competitive advantage amid global pressures. This study examines the influence of leadership competency on competitive advantage, mediated by supply chain integration, responsiveness, and agility, with supply chain digitization as a moderating variable, in manufacturing companies in Indonesia. Data were collected via an online questionnaire (Google Forms) using a 5-point Likert scale from 104 valid respondents and analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4.0 software. The results show that leadership competency has a significant positive effect on supply chain integration, responsiveness, and agility. Integration, responsiveness, and agility each have a significant positive impact on competitive advantage, with agility showing the strongest effect. The three hypothesized moderating effects of supply chain digitization were not significant. Leadership competency's effect on competitive advantage is fully mediated through supply chain responsiveness, integration, and agility. Managerially, investment in leadership development will not have an optimal impact without strengthening supply chain capabilities, especially agility. Manufacturing companies are advised to prioritize leadership training focused on rapid, adaptive decision-making to strengthen cross-functional coordination. This research contributes to enriching the current theories in supply chain management and dynamic capability.

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1. Introduction

The performance of Indonesia's manufacturing sector, the backbone of national supply chain activity, shows a clear limitation. Indonesia's manufacturing Purchasing Managers' Index (PMI) released by S&P Global was recorded at 46.9 in June 2026, down from 50.0 in the previous month and marking the second contraction throughout 2026, triggered by the fastest decline in new orders in a year and a plunge in export sales to the lowest level since August 2021 (S&P Global, 2026). The PMI figure below the 50 threshold indicates a contraction in manufacturing activity and a weakening of the global competitiveness of Indonesian companies in securing orders and maintaining export share. This condition is exacerbated by declining logistics performance: according to the World Bank's Logistics Performance Index (LPI), Indonesia's ranking dropped from 46th in 2018 to 61st out of 139 countries in 2023 (World Bank, 2023), lagging neighboring countries such as Malaysia, Thailand, and Vietnam. This combination of manufacturing contraction and weakening logistics performance indicates that many manufacturing companies in Indonesia have not succeeded in translating resources into a sustainable competitive advantage, so solutions are needed to increase manufacturing competitiveness amid these pressures.

The fundamental question is which capabilities enable companies to convert resources into competitive advantages amid these conditions. Leadership has long been seen as the starting point for developing supply chain capabilities, as leaders determine the direction, resources, and organizational culture that support integration, responsiveness, and agility (Sungbae & Taesoo,

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2016; Zada et al., 2026). Supply chain integration itself has proven to be an important antecedent for responsiveness and agility (Badwan, 2025), while agility is often positioned as a bridging capability that underpins competitive performance (Alfalla-Luque et al., 2018; Gligor & Holcomb, 2014). On the other hand, supply chain digitization, which in Indonesia is also being driven through the National Logistics Ecosystem initiative, adds layers of complexity as well as new opportunities: a number of studies show that digital technologies reinforce the influence of supply chain capabilities on performance, although the effects are reported to be not always uniform across different organizational contexts (Alyasein et al., 2025; Jafari et al., 2025).

However, not all of the empirical evidence is consistent. Chen et al. (2021), in a meta-analysis of 32 empirical journal articles on supply chain leadership and corporate performance, found that research on the influence of transformational versus transactional leadership styles on company performance remained mixed across studies, although overall, supply chain leadership was positively related to performance. A similar pattern was found in the relationship between supply chain integration and performance. Supplier integration had a significant effect on operational performance, while customer integration showed no significant effect in their research samples, a pattern of inconsistency between studies that some subsequent literature reviews referred to as the "supply chain integration paradox". Such inconsistencies indicate that the relationship between leadership, supply chain capabilities, and competitive performance is likely context-dependent and has not been fully explained by models that test these relationships in isolation, a gap that also forms the basis of this study.

Based on the description above and the inconsistencies in these findings, there are three prominent research gaps. First, empirical research still focuses on a single company, whereas multi-company dynamics and supply chain ecosystems have been explored less (Defee & Fugate, 2010). Second, the role of digitalization moderation has not received consistent empirical validation across various industries (Alyasein et al., 2025). Third, and the main focus of this study, there is no integrated model that tests the influence of leadership competency on competitive advantage through the combined mediation pathway of responsiveness, integration, and supply chain agility, with digitalization as a moderator, although the view of dynamic capabilities provides an appropriate theoretical foundation for the configuration of the model.

Departing from this gap, this study examines the influence of leadership competency on competitive advantage through the mediating roles of supply chain integration, responsiveness, and agility, with supply chain digitization as a moderating variable, in companies that carry out supply chain activities in Indonesia. This study seeks to answer two main research questions: (1) whether leadership competency affects competitive advantage through the mediation of integration, responsiveness, and supply chain agility; and (2) whether supply chain digitization moderates the relationship between supply chain capabilities and competitive advantage.

The novelty of this research lies in three things. First, this study brings leadership, integration, responsiveness, and agility together into a single explanatory framework, rather than treating them as stand-alone constructs. Second, this study empirically examines the role of digitalization moderation at the point where supply chain capabilities translate into competitive advantages. Third, this study addresses the need to understand the interaction between human leadership competency and digital capabilities in maintaining competitive advantages amid uncertainty (Ruan et al., 2025).

Theoretically, this study contributes to enriching the dynamic capability-based view and the Resource-Based View by providing an integrated model that explains how leadership competency translates into competitive advantages through supply chain capabilities, while clarifying the boundary role of digitalization as a moderator in this relationship. Practically, the findings of this study are expected to provide guidance for supply chain managers in Indonesia on determining investment priorities for leadership development, integration/responsiveness/agility capabilities, and digital transformation, to strengthen the company's competitiveness amid national logistics performance challenges. The next part of this article is organized as follows: the second part discusses the theoretical foundations and hypothesis development, the third part explains the research method, the fourth part presents the results of the analysis, and the fifth part contains the discussion, theoretical and managerial implications, limitations, and further directions for research.

2. Literature review

2.1. Grand Theory

The resource-based view emphasizes that competitive advantage arises from valuable, rare, inimitable, and non-substitutable (VRIN) resources in the context of the supply chain, including leadership competency, information integration capabilities, and digital capabilities that competitors find difficult to replicate (Jafari-Sadeghi et al., 2023). DCT (Dynamic Capabilities Theory) goes beyond RBV (Resource-Based View) by emphasizing three dynamic mechanisms, sensing, seizing, and reconfiguring, that are key determinants of competitiveness amid global supply chain volatility (Pu et al., 2023). RBV nor the DCT explicitly provides characteristics, cognition, and patterns of peak managerial attention that determine how opportunities and threats are interpreted and strategic choices are made, including how organizational attention is allocated to specific issues. The relevance of this perspective in the context of supply chains is increasingly strengthened as the role of supply chain executives in the company's strategic leadership increases (Suurmond et al., 2025).

These three theories occupy different causal chains and are complementary, rather than competing to explain the same phenomenon. Top leaders' cognition and attention allocation determine the organization's strategic choices. DCT explains how these strategic choices are transformed into organizational capabilities through the mechanisms of sensing, seizing, and reconfiguring. Integrating these three theories, this study offers a micro-macro model that explains the transmission mechanism by which the leader's individual competencies translate into organizational competitive advantages, while also addressing the need for a more explicit micro-foundation in dynamic capability-based research (Felin et al., 2015).

2.2. Leadership competency

Top management characteristics and cognition represent values and provide a cognitive basis that shapes the interpretation of the situation as well as the organization's strategic choices (Basana et al., 2026). Leadership competency refers to a leader's set of knowledge, skills, attitudes, and abilities in directing, motivating, and integrating organizational resources to achieve strategic goals (Eng et al., 2023), encompassing technical and relational dimensions such as building trust across organizations and articulating a vision of digital transformation (Xi et al., 2023). Jiang et al. (2023) define supply chain leadership competency as the ability of leaders to proactively identify risks and mobilize organizational competencies to address disruptions. This perspective aligns with DCT, which emphasizes sensing and seizing as micro-foundations of strategic leadership (Khunwishit et al., 2018; Vanpoucke & Ellis, 2020).

Leadership competency in the context of supply chain is measured through five indicators adapted from related research: (1) strategic vision: formulating and communicating the strategic direction of the supply chain (Feng et al., 2019); (2) the ability to build strategic partnerships and share risks with partners (Xi et al., 2023); (3) the ability to encourage cross-functional integration and collaboration (Xi et al., 2023); (4) adaptive decision-making: rapid and adaptive decision-making in uncertain conditions and (5) Digital Leadership Capability: Encouraging the adoption of digital technology and a culture of innovation.

2.3. Supply Chain Agility

Supply Chain Agility (SCA) is defined as the ability of the supply chain to respond to market changes quickly, effectively, and efficiently, both proactively and reactively to disruptions (Gligor et al., 2019), and is seen as a key performance driver that allows companies to mitigate risk and maintain a competitive advantage in volatile markets (Alfalla-Luque et al., 2023). Marin-Garcia et al. (2018) identified four fundamental issues in the conceptualization of SCA: response speed, agility coverage, proactive-reactive mode, and expected outcomes, and supported their findings with a meta-analysis of 63 empirical studies that affirmed the relevance of this construct across industries and cultures (Alfalla-Luque et al., 2023). Post-pandemic, SCAs evolved to include ambidextrous capabilities, exploring innovations while exploiting existing capabilities, enabling supply chains to adapt to short-term disruptions while maintaining long-term growth (Gu et al., 2021; Belhadi et al., 2021).

Supply Chain Agility is measured through five indicators adapted from related research (Sharma et al., 2024): (1) flexibility, adapting production capacity and distribution networks to fluctuations in demand; (2) responsiveness, speed to respond to changing customer needs; (3) speed, throughput speed across the entire supply chain pipeline; (4) alertness, the acuity of detecting signals of market changes early on; and (5) competency, a core capability that supports consistent agility execution.

2.4. Supply Chain Responsiveness

Supply Chain Responsiveness (SCR) refers to the ability of the supply chain to recognize and respond to changing customer needs, demand fluctuations, and external environmental pressures in a timely manner (Richey et al., 2022), as an outcome of organizational adaptation that involves close coordination between information, processes, and capacity (Wang et al., 2024). Anekal (2022) distinguishes SCR from agility: agility emphasizes the speed and flexibility of structural adaptation, while responsiveness focuses on the accuracy and accuracy of information in responding to specific customer needs, empirically confirmed to increase a company's competitive capability, especially when supported by real-time information sharing (Aldhaheri & Ahmad, 2023). Digital transformation has also been shown to increase market responsiveness through improved product quality, traceability, and visibility into product flows, indicating that responsiveness is now a function of the maturity of the digital ecosystem (Jing & Fan, 2024).

Supply Chain Responsiveness is measured through five indicators adapted from related research (Richey et al., 2022; Anekal, 2022; Wang et al., 2024): (1) demand responsiveness, detecting and responding to changes in customer demand; (2) supply responsiveness, securing the supply of raw materials in a situation of disruption; (3) information responsiveness, speed and accuracy of information transmission; (4) adjustment of operational capacity to sudden changes; and (5) adjustment of schedules and production planning to sudden changes.

2.5. Supply Chain Integration

Supply Chain Integration (SCI) is defined as a company's ability to manage and integrate internal operations and network relationships with suppliers and customers, resulting in a seamless flow of information, materials, and finances throughout the supply chain. Wang et al. (2024) extend this concept into a three-stage circular capability, visibility, agility, and flexibility,

that enables supply chain members to engage in a continuous improvement cycle. In the context of Indonesian manufacturing, Gunawan, Siagian, and Tarigan (2024) confirm that SCI, which includes internal, supplier, and customer integration, significantly improves competitive performance. Another study also found that SCI explains up to 84.7% of the variance in operational performance in companies listed on the Indonesia Stock Exchange. Theoretically, SCI is both a manifestation of RBV and a dynamic capability that continues to adapt: companies that successfully integrate their supply chains have sharper sensing and seizing capabilities for identifying market opportunities and threats.

Supply Chain Integration is measured through five indicators adapted from related research (Wang et al., 2024; Gunawan et al., 2024): (1) internal integration, coordination of processes, information, and functions within the organization; (2) supplier integration, sharing demand and capacity information in real-time with suppliers; (3) supplier integration, synchronization of production schedules and product development with suppliers; (4) customer integration, sharing request information and customization with customers; and (5) Information Integration, information system connectivity and real-time data visibility.

2.6. Competitive Advantage

Competitive advantage is defined as the ability of a company to create higher economic value than competitors through product/service differentiation, cost efficiency, or a combination of both, resulting in a superior and sustainable market position, including conditions when firms consistently perform above the industry average despite being faced with environmental uncertainties (Pu et al., 2023). In the context of supply chains, competitive advantage is no longer solely determined by internal resources, but also by the ability to integrate and optimize the entire supply chain ecosystem more effectively than competitors, in line with the evolution of RBV towards a Relational View that emphasizes unique and hard-to-replicate interorganizational relationships (Cahyono et al., 2023). Aldhaheri and Ahmad (2023) identified five key indicators of competitive advantage in the context of supply chains, product quality superiority, delivery reliability, cost competitiveness, market responsiveness, and innovation capability, that collectively reflect multidimensional constructs that go beyond short-term financial measures.

Competitive Advantage is measured through five indicators adapted from related research (Aldhaheri & Ahmad, 2023): (1) product quality superiority, superiority of product and service quality; (2) delivery reliability, the reliability and timeliness of delivery; (3) cost competitiveness, price competitiveness without sacrificing margin; (4) market responsiveness, speed in adjusting offers to market changes; and (5) innovation capability, speed and success in presenting new products/processes.

2.7. Supply Chain Digitization

Supply Chain Digitization (SCD) is defined as the process of integrating digital technologies, IoT, artificial intelligence, blockchain, big data analytics, and cloud computing, into the entire supply chain value chain processes and flows to improve end-to-end visibility, coordination, efficiency, and responsiveness (Belhadi et al., 2021; Jing & Fan, 2024), represents a fundamental transformation from a linear-manual operating model to an interconnected and real-time digital ecosystem. SCD is not just a technology adoption, but rather a paradigmatic shift in the way companies create and capture value; from DCT's perspective, it is a manifestation of dynamic capability reconfiguration that allows companies to restructure their assets and relational relationships (Zhao et al., 2023). Al Tera et al. (2024), using data from 399 Turkish manufacturing companies, showed that SCD significantly improves visibility and supply chain performance. In Indonesia, companies that successfully implement supply chain digitization have gained a competitive advantage through operational efficiency and improved market responsiveness (Jing & Fan, 2024; Elnadi, 2026).

Supply Chain Digitalization is measured through five indicators adapted from related research (Belhadi et al., 2021; Jing & Fan, 2024; Al Tera et al., 2024; Tarigan et al., 2026): (1) digital connectivity, internal digital integration between functions using IoT platforms; (2) digital connectivity, external digital integration with supply chain partners using APIs; (3) Data Analytics Capability, processing big data for strategic insights; (4) process automation, automation of operational processes using AI and robotics; and (5) Digital Visibility, monitoring the status and movement of materials, information, and finances in real-time.

2.8. Relationship Between Research Variables and Hypothesis Development

Based on the Upper Echelons Theory, the cognition and attention patterns of top leaders determine which issues are prioritized and how organizational resources are allocated. Leaders with high competence tend to direct their attention and resources on strengthening information coordination and speed of response to changing customer needs. Long-standing leadership is seen as the starting point of supply chain capabilities, influencing performance indirectly through collaboration as a mediator (Sungbae & Taesoo, 2016; Toopgajank et al., 2019). Relational competencies, trust, commitment, openness in sharing information, are also important pathways that connect leadership to supply chain performance (Abdallah et al., 2017; Barnes & Liao, 2012), while change-oriented information technology competencies strengthen organizations' ability to respond to the market through technology-based collaboration (Zada et al., 2026).

H_1: *Leadership competency affects supply chain responsiveness.*

Peak managerial attention directed toward cross-functional coordination and long-term relationships with supply chain partners helps explain why leadership competency are also the main drivers of structural supply chain integration. Transformational leadership consistently encourages external integration through strengthening long-term relationships with suppliers and sustainability orientation (Birasnav & Bienstock, 2019; Chen et al., 2021; Solis et al., 2023), while transactional leadership is more effective in supporting internal integration and operational resilience in small and medium-sized enterprises (Taseer & Ahmed, 2022; Solis et al., 2023). Strategic leadership is reported to encourage both internal and external collaboration simultaneously (Prabhu & Srivastava, 2024).

H_2: *Leadership competency affects supply chain integration.*

In line with the Upper Echelons Theory, the strategic choices of top leaders reflect how they interpret opportunities and threats in the business environment, and leadership competency also contributes to organizational agility, especially through top management's support of digital and analytical initiatives, which reinforce the impact of digital transformation on supply chain integration and performance (Jafari et al., 2025; Milojevic et al., 2026; Shafique et al., 2024). When active leaders allocate resources to adopt new technologies, organizations gain a stronger foundation for building flexibility and speed of response to market disruptions.

H3: Leadership competency affects supply chain agility.

Supply Chain Integration, Responsiveness, and Agility

Supply chain integration has been proven to be the foundation of operational efficiency, quality, flexibility, and responsiveness, which underpin competitive advantage (Anwar et al., 2025; Masa'deh et al., 2022). Integration with customers and suppliers improves transparency and value chain performance (Bosompem et al., 2024; Sègbotangni et al., 2025), while cross-functional integration strengthens partnerships and responsiveness, especially in small-medium enterprises with limited resources (Siagian et al., 2024; Badwan, 2025).

H_4: *Supply chain integration affects supply chain responsiveness.*

Integration is also a key enabler of agility through increased market sensitivity, flexibility, and speed of action (Cai et al., 2012; Gligor & Holcomb, 2014; Swafford et al., 2006). Logistics capabilities in the form of flexibility, collaboration, and differentiation are also important antecedents for agility (Gligor & Holcomb, 2014; Swafford et al., 2006). The company's ability to build a strong integration system with external and internal partners can increase strong responses to customer requests and changes (Achwan et al., 2026).

H_5: *Supply chain integration affects supply chain agility.*

All three capabilities, responsiveness, integration, and agility, are believed to translate into competitive advantage through different channels. Responsiveness allows companies to adapt quickly to changes in demand, becoming a source of strategic operational excellence, especially in industries with short demand cycles (Mandal, 2015; Emon, 2025).

H_6: *Supply chain responsiveness affects competitive advantage.*

Integration serves as a strategic asset that mediates the relationship between supply chain management and sustainable performance (Alma'abreh et al., 2026), with customer and supplier integration consistently improving competitive performance in various industry contexts (Harsasi & Minrohayati, 2017; Siagian et al., 2024). A responsive supply chain in a manufacturing company can increase flexibility, ultimately improving the company's competitiveness over time (Achwan et al., 2026).

H_7: *Supply chain integration affects competitive advantage.*

Agility has proven to be an important driver of competitive advantage, particularly through Triple-A capabilities that contribute significantly to market disruption conditions (Alfalla-Luque et al., 2018; Gomes & Silva, 2025) and often acts as a mediator between integration and competitive performance (Koç et al., 2022; Jantapoon & Somsamer, 2026). Supply chain integration is formed within the company so that external partners can understand the company's condition, supported by transparency, which can increase product competitiveness compared to other companies (Tarigan et al., 2026).

H_8: *Supply chain agility affects competitive advantage.*

Environmental conditions also shape the strength of these relationships: environmental uncertainty has a positive effect on competitive advantage through integration and agility (Koç et al., 2022), while market turmoil demands survival capabilities such as supplier diversification and inventory flexibility (Wong et al., 2011; Rakhman et al., 2016; Patrucco et al., 2025).

Supply Chain Digitization as a Moderator

Digitalization is also believed to strengthen the relationship between supply chain capabilities and competitive advantage as a boundary condition (Basana et al., 2026). Top management support moderates the strength of the relationship between big data analytics and agility and performance (Jafari et al., 2025), while technological readiness and managerial commitment are important prerequisites for successful digital technology adoption (Milojevic et al., 2026). However, these moderation effects are not always uniform: institutional pressures can negatively moderate the digitalization-agility relationship (Alyasein et al., 2025), while environmental dynamics reinforce the benefits of digital transformation in volatile market conditions (Jum'a et al., 2025). Taking this evidence into account, digitalization is predicted to strengthen, not replace, the contribution of responsiveness, integration, and agility to competitive advantage.

H_9: *Supply chain digitization moderates the relationship between supply chain responsiveness and competitive advantage.*

H_{10}: *Supply chain digitization moderates the relationship between supply chain integration and competitive advantage.*

H_{11}: *Supply chain digitization moderates the relationship between supply chain agility and competitive advantage.*

The mediating role of supply chain integration, responsiveness, and agility

Leadership competency is hypothesized to have no direct pathway to competitive advantage in this research model; The influence is predicted to be fully channelled through the supply chain capabilities discussed earlier. This logic is consistent with Dynamic Capabilities Theory, which places leadership as sensing and seizing capabilities that must first be translated into transforming capabilities, in this case, integration, responsiveness, and supply chain agility, before impacting a company's competitive position (Alzate et al., 2022). In other words, leadership competence functions as an enabling antecedent rather than a direct determinant of competitive advantage.

Given that leadership competency has been hypothesized to have an effect on integration (H2), responsiveness (H1), and supply chain agility (H3), while these three capabilities are also hypothesized to affect competitive advantage (H7, H6, H8), then logically these three capabilities are predicted to play a mediating role that channels the influence of leadership competency on competitive advantage.

H_{12}: *Supply chain integration mediates the relationship between leadership competency and competitive advantage.*

H_{13}: *Supply chain responsiveness mediates the relationship between leadership competency and competitive advantage.*

H_{14}: *Supply chain agility mediates the relationship between leadership competency and competitive advantage.*

Based on the above descriptions of each construct and the proposed hypotheses, Fig. 1 presents the corresponding research model, illustrating the constructs' positions and their relationships.

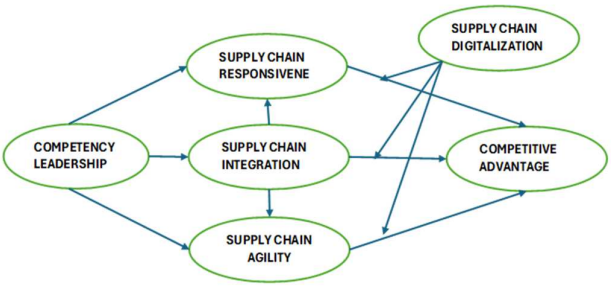

Fig. 1. Research Model

3. Research Methods

3.1 Types and Research Approaches

This study uses an explanatory quantitative research approach to test the causal relationships among variables identified in the literature review. Data were collected through surveys using a structured questionnaire on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

3.2 Population, Samples, and Sampling Techniques

The population of this study comprises managerial and operational-level employees who work in companies that carry out supply chain activities in Indonesia. The sampling technique uses purposive sampling (non-probability sampling), with the criteria that respondents are parties who understand and are directly involved in decision-making related to the supply chain

in their company, such as operational managers, supply chain/logistics managers, purchasing managers, or equivalent positions who have the authority and adequate understanding to assess the leadership practices, integration, responsiveness, agility, and digitalization of the supply chain in the company the place where it works. The questionnaire was distributed electronically, with links shared via email and professional networking to prospective respondents who met the above criteria. Each respondent filled out a self-administered questionnaire without researcher intervention to minimize measurement bias. After the data cleaning process, including checking response completeness, answer consistency, and respondent eligibility, 104 respondents were retained for further analysis using PLS-SEM, with valid and feasible data.

3.3 Operational Definition and Research Instruments

The research variables consisted of one exogenous variable (Leadership Competence), three mediating variables (Supply Chain Integration, Supply Chain Agility, Supply Chain Responsiveness), one moderation variable (Supply Chain Digitization), and one endogenous variable (Competitive Advantage). Table 1 presents the operationalization and measurement indicators for each construct, as defined in the literature review section. The indicators are assessed using a five-point Likert scale.

Table 1
Operationalization of Variables and Indicators

Variable	Code	Indicator Description	References
Leadership Competency	CL1	Strategic vision, formulating and communicating the strategic direction of the supply chain	Feng et al. (2019)
	CL2	Collaborative competence, building strategic partnerships and sharing risks with partners	Xi et al. (2023)
	CL3	Collaborative competence encourages cross-functional integration and collaboration	Xi et al. (2023)
	CL4	Adaptive decision-making, fast and adaptive decision-making under uncertain conditions	
	CL5	Digital leadership capability, driving the adoption of digital technology and a culture of innovation	Jiang et al. (2023)
Supply Chain Integration	SCI1	Internal integration, coordination of processes, information, and functions within the organization	Gunawan et al. (2024)
	SCI2	Supplier integration, sharing demand and capacity information in real-time with suppliers	
	SCI3	Supplier integration, synchronization of production and product development schedules with suppliers	
	SCI4	Customer integration, sharing request and customization information with customers	
	SCI5	Information integration, information system connectivity and real-time data visibility	Wang et al. (2024)
Supply Chain Agility	SCA1	Flexibility, adapting production capacity and distribution network to fluctuations in demand	Sharma et al. (2024)
	SCA2	Responsiveness, speed to respond to changing customer needs	
	SCA3	Speed, the throughput speed across the supply chain pipeline	
	SCA4	Alertness, acuteness detects signals of market changes early	
	SCA5	Competency, a core capability that supports consistent agility execution	
Supply Chain Responsiveness	SCR1	Demand responsiveness, detecting and responding to changes in customer demand	Richey et al. (2022); Anekal (2022)
	SCR2	Supply responsiveness, securing the supply of raw materials in a disruption situation	
	SCR3	Information responsiveness, speed and accuracy of information transmission	
	SCR4	Operational responsiveness, adaptation of operational capacity to sudden changes	
	SCR5	Operational responsiveness, adjusting production schedules/plans to sudden changes	
Competitive Advantage	CA1	Product quality superiority, the superiority of product and service quality	Aldhaheri & Ahmad (2023)
	CA2	Delivery reliability, reliability and timeliness of delivery	
	CA3	Cost competitiveness, price competitiveness without sacrificing margin	
	CA4	Market responsiveness, the speed at which supply adapts to market changes	
	CA5	Innovation capability, speed and success in delivering new products/processes	
Supply Chain Digitalization	SCD1	Digital connectivity, internal digital integration between functions using an Internet of Things (IoT) platform	Belhadi et al. (2021); Al Tera et al. (2024)
	SCD2	Digital connectivity, external digital integration with supply chain partners using Application Programming Interfaces (APIs)	
	SCD3	Data analytics capability, processing big data for strategic insights	Jing & Fan (2024)
	SCD4	Process automation, automation of operational processes using Artificial Intelligence (AI) and robotics	Belhadi et al. (2021)
	SCD5	Digital visibility, monitors the status and movement of materials/information/finances in real-time	Al Tera et al. (2024)

3.4 Data Analysis Techniques

The data were analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4, which was chosen for its suitability for predictive and exploratory models with formative and reflective constructs, as well as relatively limited sample sizes (Hair et al., 2019). The analysis was carried out in two stages. The first stage is the evaluation of the measurement model (outer model), including the convergent validity test (outer loading and average variance extracted/AVE), the reliability test (Cronbach's alpha and composite reliability), and the discriminant validity test using the Fornell-Larcker criteria and the heterotrait-monotrait ratio (HTMT) (Henseler et al., 2015). The second stage is the evaluation of the structural model (inner model), including collinearity test (VIF), determination coefficient (R^2), predictive relevance (Q^2 predict), influence magnitude (f^2) referring to Cohen (1988) guidelines, and hypothesis testing through a bootstrapping procedure with 5,000 subsamples at a significance level of 95%.

4. Analysis Results

Data analysis using PLS-SEM with the help of SmartPLS 4 on 104 valid respondents. Table 2 presents the profiles of the study respondents. Most respondents were in managerial positions (managers and supervisors) and worked in departments that were directly related to operations and supply chains, such as production, purchasing/procurement, and production planning.

Table 2
Respondents' Profile

Department/Position	Description	Frequency	%
Department of Work	Engineering	17	16,31
	Finance & Accounting	3	2,88
	Marketing	8	7,69
	Production Planning	11	10,57
	Production	35	33,65
	Purchasing/Procurement	21	20,20
	Warehouse	9	8,7
	Total	**104**	**100%**
Current position in the company	Owners	8	7,69
	Director/General Manager	3	2,88
	Manager	34	32,69
	Superintendent	5	4,81
	Supervisor	54	51,92
	Total	**104**	**100%**

Source: Primary data processed (2026), n = 104.

4.1 Evaluation of Measurement Models (Outer Model)

The measurement model is evaluated through convergent validity, internal consistency reliability, and discriminant validity. Convergent validity is assessed using outer loading and average variance extracted (AVE), where an indicator is declared valid if the outer loading value is greater than 0.50 and a construct is declared to meet convergent validity if the AVE value is greater than 0.50 (Hair et al., 2019). Reliability was assessed using Cronbach's alpha and composite reliability (rho_c) with a threshold of 0.70.

Table 3
Outer Loading, Mean, and Reliability

Construct / Indicator	Outer Loading	Mean	Remarks
Leadership Competency (CL) *α=0.812; CR=0.870; AVE=0.578*			**Reliable**
CL1 formulates and communicates the strategic direction of the supply chain	0.809	4.183	Valid
CL2 builds strategic partnerships and shares risks with partners	0.802	4.154	Valid
CL3 drives cross-functional integration and collaboration	0.712	3.952	Valid
CL4 takes quick and adaptive decisions under uncertain conditions	0.567	3.625	Valid
CL5 drives digital technology adoption and culture of innovation	0.877	4.173	Valid
Supply Chain Integration (SCI) *α=0.841; CR=0.885; AVE=0.608*			**Reliable**
SCI1 coordinates processes, information, and functions within the organization	0.798	4.269	Valid
SCI2 shares demand and capacity information in real-time with suppliers	0.860	4.058	Valid
SCI3 synchronizes production and product development schedules with suppliers	0.634	3.875	Valid
SCI4 share request and customization information with customers	0.804	4.096	Valid
SCI5 connects information systems for real-time data visibility	0.786	3.990	Valid
Supply Chain Agility (SCA) *α=0.869; CR=0.906; AVE=0.661*			**Reliable**
SCA1 adapts production capacity and distribution network to fluctuations in demand	0.809	4.298	Valid
SCA2 responds quickly to changing customer needs	0.835	4.173	Valid
SCA3 achieves throughput speeds across supply chain flows	0.861	3.981	Valid
SCA4 detects signals of market change early on	0.648	3.827	Valid
SCA5 retains core capabilities for consistent agility execution	0.892	4.163	Valid
Supply Chain Responsiveness (SCR) *α=0.819; CR=0.876; AVE=0.591*			**Reliable**
SCR1 detects and responds to changes in customer demand	0.834	4.173	Valid
SCR2 secures the supply of raw materials in disruptive situations	0.823	4.154	Valid
SCR3 transmits information quickly and accurately	0.703	3.990	Valid
SCR4 adapts operational capacity to sudden changes	0.570	3.683	Valid
SCR5 adjusts production schedules/plans to sudden changes	0.874	4.250	Valid
Supply Chain Digitalization (SCD) *α=0.890; CR=0.919; AVE=0.694*			**Reliable**
SCD1 digitally integrates internal functions using an Internet of Things (IoT) platform	0.846	4.019	Valid
SCD2 integrates digitally with supply chain partners' application programming interfaces (APIs)	0.828	3.779	Valid
SCD3 processes big data for strategic insights	0.795	3.779	Valid
SCD4 automates operational processes using Artificial Intelligence (AI) and robotics	0.843	4.067	Valid
SCD5 monitors the status and movement of materials/information/finances in real-time	0.853	4.135	Valid
Competitive Advantage (CA) *α=0.845; CR=0.890; AVE=0.619*			**Reliable**
CA1 provides product and service quality superiority	0.827	4.231	Valid
CA2 guarantees the reliability and punctuality of delivery	0.833	4.087	Valid
CA3 maintains price competitiveness without sacrificing margins	0.809	3.740	Valid
CA4 adapts offerings quickly to market changes	0.691	3.865	Valid
CA5 delivers new products/processes quickly and successfully	0.765	4.010	Valid

Source: SmartPLS 4 output, data processed (2026).

Table 3 shows that all outer loading values for the indicator are in the range 0.567–0.892, above the threshold of 0.50, so all indicators are declared valid. All six constructs also demonstrated reliability, with Cronbach's alpha and composite reliability exceeding the 0.70 threshold. The AVE value of each construct is also above the threshold of 0.50, so the convergent validity

of all constructs is confirmed. Discriminant validity was tested using the Fornell-Larcker criteria and the heterotrait-monotrait ratio of correlations (HTMT), which were considered more sensitive and reliable criteria in variance-based SEM (Henseler et al., 2015).

Table 4
Fornell-Larcker Criteria

Construct	CA	CL	SCA	SCD	SCI	SCR
CA	**0.787**					
CL	0.360	**0.760**				
SCA	0.744	0.356	**0.813**			
SCD	0.696	0.313	0.673	**0.833**		
SCI	0.513	0.442	0.356	0.367	**0.780**	
SCR	0.149	0.494	0.015	-0.066	0.154	**0.769**

Note: The value on the diagonal is the square root of the AVE of each construct. CA = Competitive Advantage; CL = Leadership Competency; SCA = Supply Chain Agility; SCD = Supply Chain Digitalization; SCI = Supply Chain Integration; SCR = Supply Chain Responsiveness.

Table 4 shows that the square root of AVE for each construct, shown on the diagonal in bold, exceeds its correlations with all other constructs, including the construct pair with the highest correlation (supply chain agility and competitive advantage). Thus, the Fornell-Larcker criteria are met for all construct pairs in the model.

Table 5
Heterotrait-Monotrait Ratio (HTMT)

Construct Pairs	HTMT
CL ↔ CA	0.420
SCA ↔ CA	0.852
SCA ↔ CL	0.417
SCD ↔ CA	0.791
SCD ↔ CL	0.384
SCD ↔ SCA	0.759
SCI ↔ CA	0.592
SCI ↔ CL	0.497
SCI ↔ SCA	0.400
SCI ↔ SCD	0.407
SCR ↔ CA	0.202
SCR ↔ CL	0.607
SCR ↔ SCA	0.109
SCR ↔ SCD	0.127
SCR ↔ SCI	0.240

Source: SmartPLS 4 output, data processed (2026).

Table 5 shows that the highest HTMT value is in the cautious range (0.85–0.90), i.e., in the Supply Chain Agility pairing with Competitive Advantage, but it remains below the conservative threshold of 0.90 (Henseler et al., 2015). All other construct pairs are well below that threshold. These findings confirm that the discriminant validity of the entire construct in the model is met.

4.2 Evaluation of Structural Models (Inner Model)

Before hypothesis testing, the structural model was evaluated for collinearity, model clarity (R^2), predictive relevance (Q^2), and magnitude of influence (f^2).

Table 6
Collinearity Statistics (VIF) - Outer Model

Indicator Blocks	VIF Range	Remarks
CA1-CA5	1,39 - 2,26	Good
CL1-CL5	1,63 - 3,49	Good
SCA1-SCA5	1,39 - 2,85	Good
SCD1-SCD5	2,32 - 3,08	Good
SCI1-SCI5	1,94 - 2,66	Good
SCR1-SCR5	1,81 - 4,05	Good

Source: SmartPLS 4 output, data processed (2026).

Table 6 shows that the overall VIF for the indicator is below the conservative threshold of 5, with the highest values in the supply chain responsiveness and leadership competency indicator blocks. This value indicates that the measurement instruments for the two constructs are quite reliable, although they remain areas for refinement in future replications.

Table 7
R-squared and R-squared Adjusted

Endogenous constructs	R^2	R^2 Adjusted
Competitive Advantage (CA)	0.696	0.674
Supply Chain Agility (SCA)	0.176	0.159
Supply Chain Integration (SCI)	0.196	0.188
Supply Chain Responsiveness (SCR)	0.249	0.234

Source: SmartPLS 4 output, data processed (2026).

Table 7 shows that the model explains the Competitive Advantage variance in the strong category, while the Supply Chain Responsiveness, Supply Chain Integration, and Supply Chain Agility variances are in the medium-to-weak category, respectively. The difference between R^2 and Adjusted R^2 values across endogenous constructs is relatively small (0.008–0.022), indicating that the addition of predictors in each structural model does not lead to overfitting. This shows that the ratio of sample size (n=104) to the number of predictors in each structural model is adequate, ensuring that the coefficient of determination can be estimated reliably and is potentially generalizable to other samples beyond this study's data (Hair et al., 2019).

Table 8
Predictive Relevance (Q^2 predict)

Endogenous constructs	Q^2 predict
Competitive Advantage (CA)	0.487
Supply Chain Agility (SCA)	0.166
Supply Chain Integration (SCI)	0.155
Supply Chain Responsiveness (SCR)	0.204

Source: SmartPLS 4 output, data processed (2026).

Table 8 shows that the Q^2 predicted value for the entire endogenous construct is positive, indicating adequate predictive relevance.

Table 9
Magnitude of Influence (f^2)

Relationships	f^2	Category Effect Size
CL → SCA	0.059	Small
CL → SCI	0.243	Medium
CL → SCR	0.300	Medium
SCA → CA	0.309	Medium
SCD × SCA → CA	0.005	None
SCD × SCI → CA	0.010	None
SCD × SCR → CA	0.003	None
SCI → CA	0.093	Small
SCI → SCA	0.060	Small
SCI → SCR	0.007	None
SCR → CA	0.057	Small

Source: SmartPLS 4 output, data processed (2026).

Table 9 shows that, referring to Cohen's (1988) guidelines, three paths of influence are classified as medium, four paths are classified as minor, and the other four paths, including the entire moderation effect of digitization, are negligible ($f^2 < 0.02$).

4.3 Hypothesis Testing

Hypothesis testing was conducted using a bootstrapping procedure with 5,000 subsamples at a 95% significance level. A hypothesis is stated to be supported if the t-statistic value is greater than 1.96 (bidirectional) and the p-value is less than 0.05. Hypotheses H9, H10, and H11 each test the moderating role of supply chain digitization in the relationships between supply chain responsiveness, integration, and agility and competitive advantage.

Table 10
Hypothesis Testing Results

Hip.	Relationships	Path Coefficient (β)	t-value	p-value	Remarks
H1	CL → SCR	0.529	5.101	0.000	Supported
H2	CL → SCI	0.442	4.809	0.000	Supported
H3	CL → SCA	0.246	2.134	0.033	Supported
H4	SCI → SCR	-0.080	0.695	0.487	Not Supported
H5	SCI → SCA	0.247	2.449	0.014	Supported
H6	SCR → CA	0.136	2.146	0.032	Supported
H7	SCI → CA	0.198	2.232	0.026	Supported
H8	SCA → CA	0.438	5.221	0.000	Supported
H9	SCD × SCR → CA	-0.032	0.516	0.606	Not Supported
H10	SCD × SCI → CA	-0.058	0.708	0.479	Not Supported
H11	SCD × SCA → CA	-0.036	0.438	0.662	Not Supported

Source: SmartPLS 4 bootstrapping output, data processed (2026).

Table 10 shows that seven of the eleven main hypotheses are supported by data. Leadership competency has a significant positive effect on all three supply chain capabilities, Supply Chain Responsiveness (H1), Supply Chain Integration (H2), and Supply Chain Agility (H3). Supply Chain Integration does not have a significant effect on Supply Chain Responsiveness (H4), but it has a significant effect on Supply Chain Agility (H5). Supply Chain Responsiveness (H6), Supply Chain Integration (H7), and Supply Chain Agility (H8) each have a significant positive effect on Competitive Advantage. The three hypotheses regarding the moderation of the relationship between Supply Chain Responsiveness (H9), Supply Chain Integration (H10), and Supply Chain Agility (H11) and Competitive Advantage are not fully supported.

4.4 Mediation Hypothesis Testing

Table 11
Results of Specific Indirect Effect Analysis (Mediation)

Code	Mediation Pathway	Coef. (β)	t-value	p-value	Remarks
H12	CL → SCI → CA	0.087	1.979	0.048	Significant
H13	CL → SCR → CA	0.072	2.104	0.035	Significant
H14	CL → SCA → CA	0.108	1.984	0.047	Significant

Source: SmartPLS 4 bootstrapping output, data processed (2026).

Table 11 shows that three mediation hypotheses proved significant. In line with the proposed mediation hypothesis, Leadership competency has an indirect effect on competitive advantage through supply chain integration (H12), supply chain responsiveness (H13), and supply chain agility (H14), thereby supporting the three mediation hypotheses.

Figure 2 presents a complete visualization of the research model, including both the outer and inner models, as discussed earlier. The outer model is shown through the relationships between each latent variable and its formative indicators, along with their loading factor values, which reflect the measurement validity of each construct. Meanwhile, the inner model is drawn using structural pathways that connect Leadership Competence, Supply Chain Agility, Supply Chain Responsiveness, Supply Chain Integration, Digital Supply Chain, and Competitive Advantage, illustrating patterns of direct influence, mediation, and moderation among latent variables. Overall, this diagram is a comprehensive visual representation of the model framework and the analysis results described earlier.

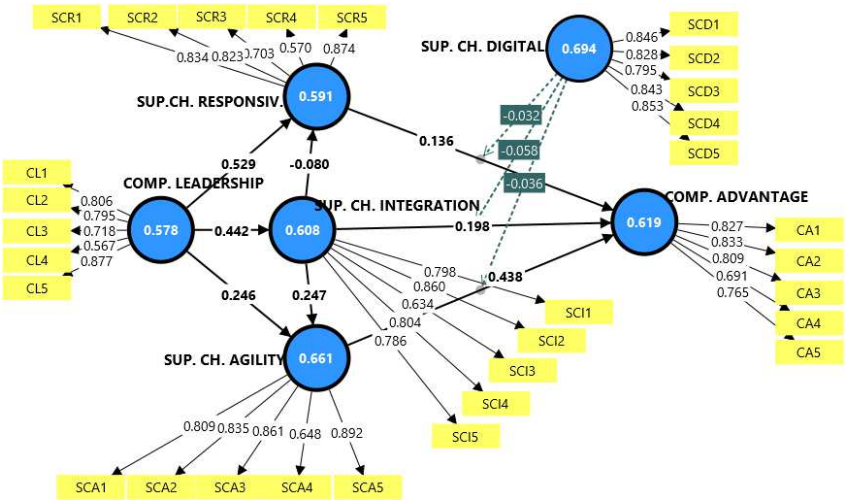

Fig. 2. Research Model and Analysis Result

5. Discussion

This study examines the influence of leadership competency on competitive advantage, mediated by supply chain integration, responsiveness, and agility, with supply chain digitization as a moderating variable. The results show that eight of the twelve main hypotheses are supported by data, as discussed below.

5.1 Leadership competency Roles (H1, H2, H3)

All three hypotheses on this pathway, the influence of leadership competency on responsiveness (H1), integration (H2), and supply chain agility (H3), are all supported, with the influence on responsiveness being the most prominent. These findings show that leadership simultaneously shapes three supply chain capabilities, in contrast to Sungbae and Taesoo (2016), who position collaboration as a single mediator between leadership and supply chain performance. The dominance of leadership's influence on responsiveness aligns with Zada et al. (2026), who found that the competence of supply chain leaders accelerates

response to demand changes. In substance, relational competence and adaptive decision-making are more readily translated into response speed than cross-functional integrations, which require longer structural investments. This pattern is consistent with evidence that transformational leadership drives supply chain integration (Birasnav & Bienstock, 2019; Chen et al., 2021), and top management support strengthens organizational agility (Jafari et al., 2025). However, the influence on agility is relatively weaker, indicating that agility is more shaped by structural factors outside of individual leadership (Alfalla-Luque et al., 2018). In practical terms, the CL1 (formulating and communicating the strategic direction of the supply chain) and CL4 (making quick and adaptive decisions in uncertain conditions) indicators directly underpin the speed of responding to market changes. In contrast, CL2 (building strategic partnerships and sharing risks with partners) explains the path to integration better, as strategic partnerships require a trust-building process that runs slower than day-to-day responsive decisions

5.2 Integration as an Antecedent of Agility, but Not for Responsiveness (H4, H5)

H5 (integration → agility) is supported, whereas H4 (integration → responsiveness) is not. This pattern is in line with the view that the integration of processes and information increases market sensitivity and speed of action, a core dimension of agility (Cai et al., 2012; Gligor & Holcomb, 2014; Swafford et al., 2006), and corroborates Wang et al.'s (2024) three-stage integration circular model, visibility, agility, flexibility, with quantitative evidence for the second stage in the context of Indonesian companies. However, H4 is different from Shukor et al. (2021), who reported that integration has a significant effect on both agility and flexibility in the manufacturing sector. This difference shows that integration in this study sample is easier to translate into medium-term adaptive capacity than the speed of responding directly to specific needs, in line with Anekal (2022), who distinguishes between agility as structural flexibility and responsiveness as accuracy and accuracy of information. Because leadership competency has explained a much larger share of the variance in responsiveness, responsiveness in this context seems to be determined more by individual leadership and decision-making than by cross-functional integration structures.

In practical terms, the SCI2 (sharing demand and capacity information in real-time with suppliers) and SCI3 (synchronizing production and product development schedules with suppliers) indicators reflect an integration process that builds medium-term adaptation capacity, so that it is more relevant to sustain agility than the daily reaction speed that responsiveness demands

5.3 Supply Chain Capabilities as Direct Drivers of Competitive Advantage (H6, H7, H8)

All three hypotheses on this pathway, the influence of responsiveness (H6), integration (H7), and supply chain agility (H8) on competitive advantage, are supported, with agility showing the strongest influence. Responsiveness enables companies to adapt quickly to changing demands, making it a source of strategic operational excellence (Mandal, 2015; Emon, 2025), although in this study its role appears stronger as a channel of leadership influence (see subchapter 5.5) than as a direct determinant of competitive advantage. Supply chain integration is a strategic asset that enhances competitive performance across various industrial contexts (Alma'abreh et al., 2026; Harsasi & Minrohayati, 2017; Siagian et al., 2024). The dominance of agility is consistent with the literature that places agility, including through Triple-A capabilities, as an important driver of competitive advantage in market disruption conditions (Alfalla-Luque et al., 2018; Koç et al., 2022), as well as reinforcing the argument of Gligor and Holcomb (2014) that among Resource-Based View-based capabilities, agility most directly contributes to competitive advantage because it includes simultaneous adaptive speed and flexibility.

In practical terms, the SCA2 (responding quickly to changing customer needs) and SCA4 (detecting signals of market changes early on) indicators illustrate how agility translates market signals into real competitive action, while CA4 (adapting offers quickly to market changes) is a direct manifestation of the competitive advantage resulting from these capabilities.

5.4 The Non-Significant Moderating Role of Digitalization (H9-H11)

Hypotheses H9, H10, and H11, the role of digitalization in moderating the relationships of responsiveness, integration, and agility with competitive advantage, are not supported. The non-significance of H9-H11 can be interpreted as a substantive pattern rather than a measurement artifact. These findings are consistent with the literature showing that the moderation effects of digitalization are contingent and non-uniform in every organizational context, including reports that institutional pressures can weaken the effects of such moderation (Alyasein et al., 2025; Jum'a et al., 2025), as well as that the effects of strengthening digitalization only appear on certain conditions of peak management support and digital maturity (Jafari et al., 2025; Milojevic et al., 2026), conditions that may not have been uniform among the companies in the study sample.

In descriptive terms, SCD4 (automates operational processes) and SCD5 (monitors the status and movement of materials/information/finances in real-time) were among the digitalization indicators with the highest mean scores, suggesting these capabilities are already well established among the sampled companies independent of their integration or agility levels. However, because this study did not estimate a direct structural path from digitalization to competitive advantage, this pattern should be read as a descriptive observation rather than evidence of a tested causal effect; whether digitalization contributes directly to competitive advantage remains an open empirical question for future research to test explicitly.

5.5 Mediating Role of Supply Chain Integration, Responsiveness and Agility (H12–H14)

The three mediation hypotheses proved significant, supporting the logic of Chapter 2 that leadership competency functions as sensing and seizing capabilities that must first be transformed through supply chain capabilities before impacting competitive advantage (Alzate et al., 2022). Because this model does not establish a direct path from leadership to competitive advantage, these results indicate full mediation: leadership competency does not necessarily translate into competitive advantage but must be channeled through strengthening integration, responsiveness, and agility. These findings are consistent with previous research indicating that leadership influences supply chain performance indirectly, mediated by collaborative capabilities (Sungbae & Taesoo, 2016; Toopgajank et al., 2019). Among the three mediators, agility shows the most prominent mediating role, consistent with its position in the literature as a bridging capability that consistently links other capabilities to competitive performance (Koç et al., 2022; Jantapoon & Somsamer, 2026). The role of integration mediation is in line with the view of integration as a strategic asset that bridges management practices and sustainable performance (Alma'abreh et al., 2026), while more moderate responsiveness mediation is consistent with its more dependent nature in the context of the industrial demand cycle (Mandal, 2015; Emon, 2025).

Managerially, this full mediation pattern emphasizes that investment in leadership development will not be optimal without strengthening supply chain capabilities, especially agility. Companies are advised to design leadership training in an integrated manner to strengthen market response speed and cross-functional coordination, as the combination of the two determines the extent to which leadership competency can translate into real competitive advantage.

6. Conclusion

This study examined the direct, moderating, and mediating relationships linking leadership competence to competitive advantage through supply chain integration, responsiveness, and agility, with supply chain digitization as a moderating variable. Most of the direct relationships were supported by the data, all three moderating relationships were not supported, and all three mediating relationships were fully supported. Leadership competence proved to be a significant antecedent of supply chain responsiveness, integration, and agility, but had no direct influence on competitive advantage, its influence was entirely indirect, channeled through integration, responsiveness, and agility. Supply chain integration was found to strengthen agility but not responsiveness. Responsiveness, integration, and agility each proved to be direct drivers of competitive advantage, with agility exerting the strongest influence. The moderating role of supply chain digitization was not supported, even though the measurement model demonstrated confirmed discriminant validity. However, its relationship with competitive advantage remains an open question that this study's design cannot resolve.

Theoretical Contributions

The findings substantiate the three theoretical contributions declared in the Introduction. First, by demonstrating that leadership competence affects competitive advantage entirely through supply chain integration, responsiveness, and agility, this study validates the integrated explanatory framework proposed at the outset, confirming that these constructs function jointly as a transmission mechanism rather than as isolated determinants, consistent with the extended Resource-Based View and Dynamic Capabilities Theory. Second, the empirical result that the hypothesized moderating role of digitalization was not supported refines rather than confirms the intended theoretical contribution regarding the boundary condition of digitalization: rather than reinforcing the capability–performance relationships as hypothesized, digitalization's non-significant moderation indicates that its influence, if any, likely operates through a mechanism this study's moderation-only design was not equipped to detect. Third, the pattern in which leadership competence requires digitally aware supply chain capabilities to translate into competitive outcomes supports the study's aim of clarifying the interaction between human leadership and digital capability under conditions of market uncertainty, extending Upper Echelons Theory's micro-foundational logic into the digital supply chain context.

Practical Contributions

Practically, the results provide the evidence base promised in the Introduction for supply chain managers' investment decisions. Because leadership competence proved to have no direct effect on competitive advantage, managers are advised against treating leadership development as a stand-alone investment; it should instead be paired deliberately with initiatives that build integration, responsiveness, and especially agility, the capability with the strongest direct link to competitive advantage. At the same time, the finding that digitalization's hypothesized moderating role was not supported suggests managers should not assume digital transformation automatically amplifies the returns from other supply chain capabilities; its contribution to competitive advantage should be evaluated on its own evidence rather than assumed, pending further research that tests its direct effect explicitly. Together, these findings give Indonesian manufacturing managers a clearer basis for sequencing investment: strengthening agility as the primary lever for competitive advantage, treating leadership development as an enabling rather than terminal contributor to competitiveness, and monitoring, rather than presuming, the value of digitalization investments until their direct contribution is more clearly established.

Limitations and Further Research

Future research is advised to monitor the potential conceptual overlap between the constructs. Second, a sample of 104 respondents from a single research context limited the generalizability of the findings; replication across broader sectors and regions is recommended. Third, this study uses cross-sectional self-report survey data, so it cannot definitively determine the direction of causality; longitudinal or multi-respondent designs are recommended for further research. Finally, because this study's model did not include a direct structural path from digitalization to competitive advantage, its non-significant moderating role cannot be interpreted as evidence for or against a direct effect; future research should explicitly estimate this direct path, test alternative moderators on the digitalization–competitive advantage relationship, or break down supply chain digitization into more specific sub-dimensions to more clearly separate its role from supply chain agility.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, the author(s) used an AI-based language model (Claude, Anthropic) to assist with English-language translation and editing, verification and formatting of bibliographic references in APA style, organization of statistical output tables derived from SmartPLS 4 analysis, and structuring of the hypothesis development and results sections. The tool was not used to generate, analyze, or interpret the underlying research data, nor to draw the study's substantive theoretical or empirical conclusions. All AI-assisted content was reviewed, verified, and edited by the author(s), who take full responsibility for the accuracy, integrity, and originality of the final published article.

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