Contents lists available at GrowingScience

International Journal of Data and Network Science

homepage: www.GrowingScience.com/ijds

Driving competitive advantage through internal, supplier, and customer integration with artificial intelligence adoption

Ruth Srininta Tarigan[a], Zeplin Jiwa Husada Tarigan[a*], Maria Natalia Damayanti Maer[a], Sautma Ronni Basana[a], Hotlan Siagian[a] and Umol Syamsul Rakiman[b]

[a]*School Business Management, Petra Christian University, Surabaya, Indonesia*
[b]*Faculty of Business and Management, Universiti Teknologi MARA Perak Branch, Malaysia*

C H R O N I C L E

Received August 25, 2025
Received in revised format December 15, 2025
Accepted December 22 2025
Available online December 28 2025

Keywords:
Internal Integration
Supplier integration
Customer Integration
Artificial intelligence
Competitive advantage

A B S T R A C T

Business competition puts pressure on companies to improve their competitive advantage. Companies utilize technology to develop innovative products that offer added value and benefit. This study aims to determine the impact of supply chain integration (internal, supplier, and customer integration) in building company competitiveness through the adoption of artificial intelligence. Data collection was conducted on 252 manufacturing companies in Java, Indonesia, the center of the manufacturing industry, using direct distribution and Google Forms. Data processing was carried out using SmartPLS 4, with the results indicating that supply chain integration, specifically internal integration, has a significant impact on supplier integration, customer integration, and the adoption of artificial intelligence. Supplier integration has a significant effect on customer integration, the adoption of artificial intelligence, and a company's competitive advantage. Customer integration is having a substantial impact on the adoption of artificial intelligence and the competitive advantage it provides. The results offer a practical contribution to company management, enabling them to invest wisely in technologies that enhance competitiveness. Companies need to involve cross-functional and external partners in supporting business activities to support technology implementation, allowing rapid adaptation and improved performance.

© 2026 by the authors; licensee Growing Science, Canada.

1. Introduction

Globalization enables companies to develop long-term strategies that ensure business continuity amid intense competition between businesses in terms of knowledge and innovation (Tran, 2025). Companies strive to develop effective strategies to maintain their competitive edge. Companies can accurately determine their current position and anticipate changes. Sustainable competitiveness can be achieved by companies possessing values that are difficult for competitors to imitate. This competitiveness can be in the form of superior product quality. Companies can also leverage responsiveness as a competitive advantage. Manufacturing companies can carry out continuous and consistent innovation in producing products that meet market needs (Rajaguru & Matanda, 2019; Abeysekara et al., 2019). Sustainable competitiveness is achieved by engaging internal functions and external partners to ensure synchronization with ongoing changes. Companies are expected to build internal integration to ensure adequate communication and coordination (Tarigan et al., 2024). Strong internal integration between management functions can result in rapid decisions that align with external conditions and the company's internal strengths. Internal and external integration, a form of supply chain integration, fosters strong relationships between components, enabling optimal operation in modern business systems. Internal integration connects process activities, facilitating the coordination of information and resources to ensure a seamless workflow within the company. Alignment between internal company functions facilitates easy communication of external information flows. Internal company functions can quickly understand external needs and changes. External changes can be aligned and efficient with internal company conditions (Birasnav & Bienstock, 2019; Yuan et al., 2022).

* Corresponding author
E-mail address: zeplin@petra.ac.id (Z. J. H. Tarigan)

ISSN 2561-8156 (Online) - ISSN 2561-8148 (Print)
© 2026 by the authors; licensee Growing Science, Canada.
doi: 10.5267/j.ijdns.2025.12.005

Internal and external integration is crucial for companies that are accelerating digitalization and enhancing global information transparency (Basana et al., 2025). A company's ability to generate partial efficiencies is insufficient to achieve overall competitiveness. Companies need to synergize and coordinate their internal and external processes to address rapid change effectively. Establishing supply chain integration within a company can create strong synergy across all components of the supply chain. Internal integration within a company can unite all functions to coordinate systematically and effectively. All functions can access the information flow generated within the company promptly. The data accessed is accurate and sufficiently complete according to the needs of each function within the company (Munir et al., 2020). Companies can leverage certain advantages by having valid data, thanks to the speed of coordination and synergy between functions, which enables the production of reliable decisions. Internal integration can partially reduce the role of functions, allowing them to work simultaneously and accelerate data flow between departments, thereby facilitating synchronization. Integration can foster understanding between departments that share the same goals, thereby facilitating informed decision-making using the latest data (Chunsheng et al., 2019; Yu et al., 2019).

Strong internal and external integration can accelerate cross-functional and cross-organizational coordination, resulting in synchronous planning (Munir et al., 2020). Integration allows companies and suppliers to communicate using the same data for procurement and new product development. The same approach can be applied internally to build effective communication with customers, producing products that meet criteria, meet turnaround times, and ensure on-time delivery (Liu et al., 2021; Jambulingam & Kathuria, 2020). Internal integration enables companies to address complex problems by processing data into complete and accurate information (Tarigan et al., 2024). Companies with integrated information systems can accommodate and distribute information as needed to all internal functions. The information obtained can be shared with external partners to assess the company's condition and plan accordingly. Internal and external integration, as supply chain integration, is fundamental to achieving superior operational performance. Companies can gain an advantage by aligning internal information flows with those of their supplier and customer partners, utilizing a single data source, and enabling effective collaboration.

Established supplier integration can facilitate joint activities between the company and its suppliers in planning raw material procurement according to needs. Suppliers receive comprehensive information from the company regarding material quality requirements, ensuring timely procurement. Collaboration between the company and its suppliers facilitates the quicker and easier resolution of emerging issues. With full support from suppliers in maintaining stable material procurement, the company will be more responsive and able to respond to market changes (Basana et al., 2025). Established supplier integration can retain flexibility for the company in the face of market dynamics. Customer integration built by companies can facilitate product procurement planning in accordance with market needs. Companies can adjust their production capacity to meet the needs of finished product delivery by obtaining rapid information from customers. Integration with customers through information sharing can increase flexibility in product distribution (Shukor et al., 2021; Tan et al., 2022). Companies can anticipate customer needs by maintaining optimal inventory levels, thus adjusting costs accordingly. Customer integration fosters strong relationships between companies and their customers, thereby enhancing competitive advantages that are difficult for competitors to replicate. Strong customer integration occurs when companies can understand customer needs and build a harmonious service system. Companies can share information with customers regarding the number of requests they have received. The company's ability to coordinate with customers for timely product delivery can be a business strategy to increase competitiveness (Shukor et al., 2021). External integration within a company can maintain optimal inventory levels, thereby reducing costs (Jajja et al., 2018; Sundram et al., 2020).

Targeted adoption of artificial intelligence can facilitate rapid internal cross-functional integration, enabling the production of aligned and tailored decisions. Adopting artificial intelligence can reduce and even eliminate waste within a company (Wamba-Taguimdje et al., 2020; Mukherjee et al., 2024). Adopting artificial intelligence can transform a company into an innovative manufacturer, enabling a robust automation system. Artificial intelligence can replace the tasks and functions of employees in performing complex processes. Artificial intelligence technology can allow a company to consistently maintain production capacity and product quality (Leoni et al., 2022; Younis et al., 2022; Paesano, 2023).

Artificial intelligence companies have adopted automation systems driven by computer systems that mimic human intelligence and can be integrated with the company's production systems. The results of these processes can be integrated with the company's internal data systems, creating a robust integration that provides information. Artificial intelligence, including machine learning and deep learning technologies, increases the efficiency and flexibility of production processes. The adoption of artificial intelligence enables companies to develop dynamic capabilities that can quickly adapt to change. An artificial intelligence system used can accelerate the process because it can work automatically and detect process instability to anticipate uncertainty in the business environment (Leoni et al., 2022; Chen et al., 2022). A system that works automatically can provide information in real-time, which is a key achievement of artificial intelligence in companies aimed at improving performance. Supply chain integration can support the adoption of artificial intelligence, enabling the organization to capitalize on the capabilities of the organization and the company's competitiveness.

Based on the explanation above, four broad research objectives can be identified, namely, firstly, to determine the extent of the influence of internal integration on supplier integration, customer integration, and the adoption of artificial intelligence.

Second, to find out the magnitude of the impact of supplier integration on customer integration, artificial intelligence adoption, and competitive advantage. Third, to obtain the magnitude of the influence of customer integration on artificial intelligence and competitive advantage. Fourth, artificial intelligence has a significant impact on a competitive advantage in manufacturing companies.

2. Literature Review

2.1. Internal Integration, supplier integration, and customer integration.

Internal integration within a company enables cross-functional teams to coordinate quickly by utilizing a single database, thereby leveraging the same information for various activities (Munir et al., 2020). Internal divisions within the company can be quickly connected, creating internal functional alignment and aligning roles with external partners, suppliers, and customers (Chunsheng et al., 2019; Yu et al., 2019). Integration within a company can reduce communication barriers between functions, thus minimizing coordination time. Internal integration, utilizing updated information technology, can eliminate the partial role of tasks that have been working simultaneously by leveraging digital technology and automation systems (Birasnav & Bienstock, 2019). Internal integration facilitates management in ensuring that all company units participate in achieving strategic goals (Tarigan et al., 2024). Integration provides equal access to all functions, allowing users to utilize the data warehouse according to their respective roles. Data integration within a company facilitates the provision of real-time data during routine meetings and also anticipates external changes by utilizing the data warehouse (Liu et al., 2021). Internal integration provides a reliable mechanism for companies to monitor activities between departments involved in the production of goods and services, ensuring they remain aligned with organizational policies (Dhaigude et al., 2021).

Supply chain integration within a company fosters a synergistic connection between internal and external partners, enabling them to collaborate on activities that lead to improved company performance (Birasnav & Bienstock, 2019). Supplier integration refers to the integration that occurs between a company and external partners in carrying out various synergistic activities, whereas customer integration involves aligning activities with customers. The use of information technology can be integrated to combine data from suppliers, customers, and partners, which is facilitated by adequate internal integration (Yuan et al., 2022). Internal integration, combined with supplier and customer integration, enables companies to unify their business processes, thereby reducing multiple activities and increasing efficiency and effectiveness, leading to improved operational performance. Companies can foster strong collaboration between internal and external stakeholders (suppliers and customers) by integrating business processes to enhance performance (Dhaigude et al., 2021). Internal integration within a company can serve as a basis for adopting artificial intelligence.

The use of integrated internal data can create a coordination pattern to improve supplier integration by communicating raw material needs and characteristics. Internal integration enables companies to develop customized solutions for customers, tailoring new or existing products to meet the capabilities of suppliers (Tan et al., 2022). Internal integration within a company can improve customer integration by jointly arranging delivery schedules and volumes. Customer participation in company integration, involving forecasting market dynamics and product distribution planning, will run smoothly when internal integration is stable (Shukor et al., 2021). Internal integration influences supplier and customer integration by forming collaborations in maintaining a balance between raw material availability and customer order fulfillment. Internal integration can involve suppliers and customers in decision-making to ensure the smooth flow of resources in the supply chain. Consistency in internal integration can lead to external integration, resulting in collective performance in implementing joint policies to enhance competitiveness (Jajja et al., 2018). Information exchange within the company fosters internal integration, enabling seamless product integration among customers, producers, and suppliers (Liu et al., 2021). The stability created between internal integration and customer integration is determined by supplier integration in providing product criteria to align with customer product specification requests. Established supplier integration can generate significant flexibility in meeting customer demand, thus impacting customer integration (Chaudhuri et al., 2018). The role of supplier integration enables companies to reduce production lead times and optimize inventory, thereby facilitating increased customer integration through collaborative forecasting (Sundram et al., 2020).

Based on the explanation above, the research hypothesis can be determined, namely:

H_1: *Internal integration within the organization has an impact on supplier integration in manufacturing companies.*
H_2: *Internal integration within the organization has an impact on customer integration in manufacturing companies.*
H_3: *Supplier integration within the organization has an impact on customer integration in manufacturing companies.*

2.2. Supply chain integration and artificial intelligence adoption

A company's ability to carry out activities using automated systems in accordance with business needs to support company performance through artificial intelligence (Chen et al., 2022). Companies can adopt artificial intelligence to help established business goals by implementing it in business activities that align with their characteristics. (Younis et al., 2022) state that artificial intelligence can mimic human intelligence in carrying out specific tasks under stable control. Dhamija & Bag (2020)

state that the use of computers in companies with artificial intelligence can make business processes more effective and efficient, and produce high-quality processes. Information technology used by companies as a form of data-based internal and external integration can impact the adoption of artificial intelligence in conducting market forecasts and supporting strategic decision-making (Mukherjee et al., 2024). The resulting data integration can support artificial intelligence to automatically collect data that can be utilized collaboratively with external partners (Nayal et al., 2022). The role of artificial intelligence in companies can be a driver of automation systems, providing accurate information related to business processes that are utilized collaboratively by supplier partners and customers (Helo & Hao, 2022). Al-Khatib et al. (2024) stated that the manufacturing sector is utilizing generative AI to manage business activities and optimize performance. Internal and external integration, a form of supply chain integration, enhances the effectiveness of processes from upstream to downstream in supply chain operations (Younis et al., 2022). Artificial intelligence is now a crucial technology because it can replace human capabilities in executing processes and solving complex problems through advanced computing (Leoni et al., 2022). This condition encourages companies to develop management frameworks that can integrate human and machine collaboration to produce optimal decisions (Kaplan & Haenlein, 2020). Artificial intelligence in companies enables rapid response to supply chain flows for evaluation, thus necessitating adequate integration. Leoni et al. (2022) stated that artificial intelligence can provide more accurate decisions because it has data integration, providing complete information. Internal supply chain integration, which can collect and provide real-time data, can enhance external (supplier and customer) integration by coordinating according to shared needs (Serrano-Torres et al., 2025). Supply chain integration in energy companies can improve capability and innovation by adopting artificial intelligence in China (Wang & Zhang, 2025). Al-Khatib et al. (2024) stated that supply chain integration used across all cross-functionalities can support supplier integration in raw material planning and customer integration in demand planning in Jordanian manufacturing. Based on the explanation above, the following research hypothesis can be formulated:

H_4: *Internal integration within the organization has an impact on the adoption of artificial intelligence in manufacturing companies.*
H_5: *Supplier integration within the organization has an impact on the adoption of artificial intelligence in manufacturing companies.*
H_6: *The integration of customers within the organization has an impact on the adoption of artificial intelligence in manufacturing companies.*

2.3. Competitive advantage

Business goals are the objectives that guide a company's business activities, ensuring its continued existence amidst competition and enhancing its competitive advantage (Rajaguru & Matanda, 2019; Abeysekara et al., 2019). Companies consistently strive to produce value-added products that are unique to consumers. On-time delivery, a key strength of a company, and the ability to deliver high-quality products can enhance its competitive advantage (Nenavani & Jain, 2022). A company's resilience in a dynamic market can be maintained over the long term as a competitive advantage (Panahifar et al., 2018). Products that are difficult for competitors to imitate will have long-term benefits, enhancing their position as a superior competitive force (Yu et al., 2019). Competitive advantage is the role of all components within the company, including the balance between customers and suppliers. Supplier and customer integration, which can create operational efficiency, also generates added value that provides sustainable benefits for customers. A company's competitive advantage is determined by supply chain integration, which aligns internal and external functions (Huo et al., 2019). Supplier chain integration, which encompasses supplier and customer integration, can produce high-quality products by ensuring suppliers provide adequate raw materials and customers clearly define product characteristics, thereby increasing competitiveness. Nenavani and Jain (2022) state that new products, as a company's advantage over competitors, are obtained from strategic supplier partnerships, a best practice in supplier integration.

The use of artificial intelligence in the business world has been proven to significantly contribute to increased productivity and the development of new processes, which in turn impact overall company performance (Wamba-Taguimdje et al., 2020). Kim & Kim (2025) state that artificial intelligence can enhance company competitiveness by increasing efficiency and improving service ease. Based on the explanation above, the research hypothesis can be stated as follows:

H_7: *Supplier integration influences competitive advantage.*
H_8: *Customer Integration has an impact on competitive advantage.*
H_9: *Adoption of Artificial Intelligence has an effect on competitive advantage.*

Based on the explanation above, the research conceptual framework can be determined in Fig. 1.

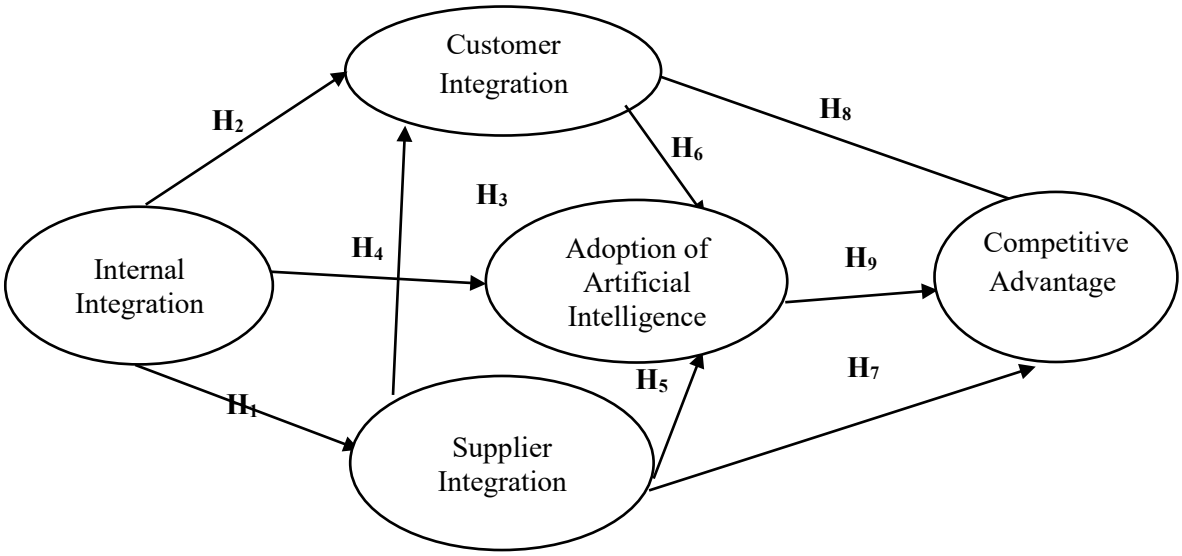

Fig. 1. Conceptual framework of supply chain integration research on competitive advantage through the adoption of artificial intelligence

3. Research Methods

This study is a causal descriptive investigation examining the impact of supply chain integration on competitive advantage through the adoption of artificial intelligence, to establish nine research hypotheses. The population was determined by medium-sized companies in provinces on the island of Java, and it cannot be officially determined. The sample size for this research was determined based on population criteria, with a minimum of 144 companies and a 10% margin of error. The questionnaire for this study was distributed using Google Forms and direct distribution to respondents, and the results were obtained from a total of 252 medium and large companies. Data collection incurs a significant cost, enabling researchers to secure research grants from the government through a competitive proposal submission process. Researchers have identified that companies with an existing internal integration system, often accompanied by the presence of enterprise resource planning software and the use of automated machines in their production processes, are more likely to succeed. Data collection utilized a questionnaire comprising measurement items presented in closed-ended questions, employing a Likert scale (Strongly disagree = 1 and Strongly agree = 5).

Measurements established for internal integration by adopting measurement items relevant to the manufacturing industry in research conducted by Liu and Lee (2018) are providing employees capable of interconnecting departments (II.1), integration between departments can be carried out well (II.2), use of accurate and consistent information systems (II.3), related departments can access the warehouse system (II.4), integration applications between departments can run effectively (II.5). Measurements established for supplier integration by adopting research conducted by Shukor et al. (2021) namely information exchange with suppliers through information networks (SI.1), material ordering systems can be carried out quickly to suppliers (SI.2), companies build strategic partnerships with suppliers (SI.3), stable procurement can be carried out with suppliers (SI.4), and supplier participation in company processes (SI.5).

The measurements set for customer integration by adopting research conducted by Freije et al. (2022) are sharing information with customers about the market (CI.1), the company pays attention to customer input (CI.2), the company provides access to technology for key customers to obtain information (CI.3), sharing information about company planning (CI.4), and sharing information about company forecasting (CI.5).

The measurements set for the adoption of artificial intelligence by adopting Tarigan et al. (2025) namely the production process is carried out using automated machines (AAI1), the company's ability to control the automation process with a computer system (AAI2), control of the company's inventory system using a computer system (AAI3), the ability of staff to operate computers with excellence (AAI4), the integrated system on the computer can consider strategic decisions (AAI5).

The measurement set on competitive advantage by adopting research conducted by Siagian et al. (2024), Abeysekara et al. (2019) and Rajaguru & Matanda (2019) namely better product sales than main competitors (CAd1), better company flexibility than main competitors (CAd2), better company product delivery than main competitors (CAd3), company growth shows increasing profits (CAd4) and reliable product quality (CAd5). The results of the questionnaire distribution obtained were 252 respondents from small and medium-sized companies, which can be processed using SmartPLS version 4 to answer all research hypotheses.

4. Research processing and analysis

Data collection was obtained with 152 male respondents and 100 female respondents. Respondents' length of service of 2 to 5 years amounted to 62 respondents, 6 to 9 years amounted to 16 respondents, and employees with more than 9 years amounted to 175 respondents. The location areas for data collection using Google Forms and direct methods are as follows: Banten Province 8 companies), Special Region of Jakarta (23 companies), Yogyakarta (13 companies), West Java 41 companies), Central Java 56 companies), and East Java (112 companies). Characteristics based on the number of workers were as follows: 30 to 50 people (40 companies), 50 to 100 people (33 companies), 100 to 200 people (21 companies), and more than 200 people (159 companies).

The results of data processing, as a form of analysis using SmartPLS, were used to obtain the criteria for the goodness-of-fit model. The first stage of processing was obtained for CA.1 (product sales are better than the leading competitor), with an outer loading value of less than 0.500, so that the second stage of processing was carried out, with the results in Table 1.

Table 1
The Criteria Goodness of Fit Model

Item	Mean	Factor Loading	Composite reliability	Cronbach Alpha
Internal Integration	4.026		0.825	0.741
II.1	4.345	0.788		
II.2	4.127	0.745		
II.3	3.865	0.638		
II.4	3.853	0.597		
II.5	3.940	0.707		
Supplier Integration	4.195		0.789	0.855
SI.1	4.210	0.770		
SI.2	4.377	0.721		
SI.3	4.067	0.721		
SI.4	4.206	0.734		
SI.5	4.115	0.734		
Customer Integration	3.952		0.825	0.875
CI.1	3.909	0.762		
CI.2	4.246	0.799		
CI.3	4.258	0.780		
CI.4	3.325	0.714		
CI.5	4.020	0.763		
Adoption of Artificial Intelligence	3.945		0.789	0.854
AA11	4.103	0.735		
AA12	4.048	0.675		
AA13	3.853	0.584		
AA14	3.889	0.842		
AA15	3.833	0.821		
Competitive Advantage	4.247		0.748	0.832
CAd2	4.103	0.778		
CAd3	4.393	0.890		
CAd4	4.214	0.812		
CAd5	4.278	0.761		

Based on Table 1, the model has passed the validity and reliability tests, thus meeting the goodness-of-fit model test. Hypothesis testing was obtained by carrying out the next stage of processing using Bootstrapping, as shown in Fig. 2 and Table 2.

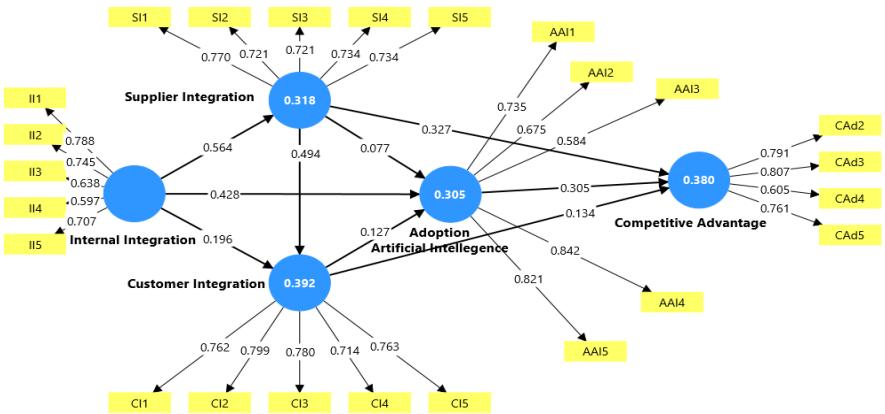

Fig. 2. PLS output: the effect of supply chain integration on competitive advantage melalui artificial intelligence adoption

Table 2
Path Coefficient

Path Coefficient	Original sample	T statistics	P values
Internal Integration → Supplier Integration	0.564	12.017	0.000
Internal Integration → Customer Integration	0.196	3.081	0.002
Supplier Integration → Customer Integration	0.494	6.787	0.000
Internal Integration → Adoption of Artificial Intelligence	0.428	5.690	0.000
Supplier Integration → Adoption of Artificial Intelligence	0.077	0.949	0.343
Customer Integration → Adoption of Artificial Intelligence	0.127	1.653	0.100
Supplier Integration → Competitive Advantage	0.327	4.726	0.000
Customer Integration → Competitive Advantage	0.134	1.774	0.076
Adoption of Artificial Intelligence → Competitive Advantage	0.305	4.638	0.000

The results of the hypothesis testing, shown in Table 2, obtained for the first hypothesis, namely that internal integration within the organization has a positive impact on supplier integration in manufacturing companies, are 0.564 and a t-statistic of 12.017 (>1.96). This suggests that the company's ability to provide employees capable of interconnecting between departments, combined with the use of accurate and consistent information systems, can enhance internal integration and, in turn, increase supplier integration. The second hypothesis, which involves internal integration within the organization, has an impact on customer integration in manufacturing companies, with a coefficient of 0.196 and a t-statistic of 3.081 (>1.96). Internal integration, including inter-departmental integration applications that run effectively, can positively impact customer integration by increasing information sharing about company planning and forecasting with customers. The third hypothesis, that supplier integration within the organization has an impact on customer integration in manufacturing companies, obtained a correlation coefficient of 0.494 and a t-statistic of 6.787 (>1.96). Supplier integration can meet customer needs through data integration, as the increased material ordering system can be executed quickly with suppliers, and stable procurement can be maintained.

The fourth hypothesis states that internal integration within the organization has a significant impact on the adoption of artificial intelligence in manufacturing companies, with a correlation coefficient of 0.428 and a t-statistic of 5.690 ($p < 0.001$). Internal integration in companies, determined by integration between departments, can be implemented effectively. The use of accurate and consistent information systems has a significant impact on the adoption of artificial intelligence, enhancing the company's ability to control the automation process and manage the inventory system through a computer system. The fifth hypothesis, that supplier integration within the organization has an impact on the adoption of artificial intelligence in manufacturing companies, yields a p-value of 0.077 and a t-statistic of 0.949 (<1.96), indicating that it is not significant. The test results indicate that stable procurement can be achieved with suppliers,, and the participation of suppliers in the company's process, as supplier integration, does not directly determine the increase in the adoption of artificial intelligence. This is carried out through automation using a computer system. The sixth hypothesis, which determines the impact of customer integration within the organization on the adoption of artificial intelligence in manufacturing companies, yields a coefficient of 0.127 and a t-statistic of 1.653 (>1.65), indicating significance at the 10% level. Customer integration is formed by providing technological access for key customers to obtain information that can influence the adoption of artificial intelligence in running production processes carried out by machines through automation and inventory system control using computer systems.

The seventh hypothesis, supplier integration, has a 0.327 effect on competitive advantage, with a t-statistic of 4.726 ($p < 0.001$). Supplier integration, established through a material ordering system, can be carried out quickly. The company's ability to build strategic partnerships can enhance its competitive advantage by delivering superior products to its main competitors and ensuring reliable product quality. The eighth hypothesis, customer integration, has a 0.134 effect on competitive advantage, with a 1.774 t-statistic (greater than 1.65) and a significance level of 10%. This condition indicates that the company pays close attention to customer input and shares information about company planning and forecasting, which has an impact on increasing competitive advantage. The ninth hypothesis, established through the adoption of artificial intelligence, has a 0.305 effect on competitive advantage, with a 4.638 t-statistic (greater than 1.96). The company's ability to adopt artificial intelligence is demonstrated by its control over automation processes and inventory systems through computer systems, supported by the staff's proficiency in operating computers. This combination provides an increase in competitive advantage, as evidenced by enhanced flexibility, improved product delivery, and increased profit growth.

5. Conclusion

The research results demonstrate the importance of supply chain integration in generating competitive advantage in manufacturing companies. Supply chain integration, both internal and external (including suppliers and customers), forms the foundation for building sustainable competitiveness in manufacturing businesses. Model testing results indicate that internal integration has a significant influence on supplier integration, customer integration, and the adoption of artificial intelligence. These findings demonstrate that cross-functional coordination and consistent use of information systems within a company can serve as the basis for stronger external collaboration. Meanwhile, supplier integration has been shown to have a significant influence on customer integration and competitive advantage, although it does not directly impact the adoption of artificial

intelligence. Customer integration has also been shown to be relevant in strengthening competitive advantage, although its role in driving artificial intelligence is only significant to a certain extent. Furthermore, the adoption of artificial intelligence significantly contributes to increasing a company's competitive advantage through efficiency, flexibility, and its ability to produce consistent, value-added products.

Acknowledgments

The authors would like to thank **Director of Research and Community Service, Higher Education Indonesia for providing the grant** for providing the grant ID **128/C3/DT.05.00/PL/2025**, and to Research and Community Outreach Petra Christian University with contact number 002/LL7/DT.05.00/PL/2025, 005/PFR/LPPM-UKP/2025 and collaboration agreement between Petra Christian University-UiTM with number 0284/UKP/2025.

References

Abeysekara, N., Wang, H., & Kuruppuarachchi, D. (2019). Effect of supply-chain resilience on firm performance and competitive advantage: A study of the Sri Lankan apparel industry. *Business Process Management Journal*, *25*(7), 1673–1695. https://doi.org/10.1108/BPMJ-09-2018-0241

Al-khatib, A. W., AL-Shboul, M. A., & Khattab, M. (2024). How can generative artificial intelligence improve digital supply chain performance in manufacturing firms? Analyzing the mediating role of innovation ambidexterity using hybrid analysis through CB-SEM and PLS-SEM. *Technology in Society*, *78*, 102676. https://doi.org/10.1016/j.techsoc.2024.102676

Basana, S. R., Malelak, M. I., Siagian, H., Tarigan, R. S., Tarigan, Z. J. H., & Nasir, Z. A. B. (2025). Rethinking operational decisions making: Strategic drivers from management commitment, supply chain transparency and integration. *Decision Science Letters*, 14(4), 837–848. https://doi.org/10.5267/j.dsl.2025.8.005

Birasnav, M., & Bienstock, J. (2019). Supply chain integration, advanced manufacturing technology, and strategic leadership: An empirical study. *Computers & Industrial Engineering*, *130*, 142–157. https://doi.org/10.1016/j.cie.2019.01.021

Chaudhuri, A., Boer, H., & Taran, Y. (2018). Supply chain integration, risk management and manufacturing flexibility. *International Journal of Operations & Production Management*, *38*(3), 690–712. https://doi.org/10.1108/IJOPM-08-2015-0508

Chen, W., Liu, C., Xing, F., Peng, G., & Yang, X. (2022). Establishment of a maturity model to assess the development of industrial AI in smart manufacturing. *Journal of Enterprise Information Management*, *35*(3), 701–728. https://doi.org/10.1108/JEIM-10-2020-0397

Chunsheng, L., Wong, C. W. Y., Yang, C.-C., Shang, K.-C., & Lirn, T. (2019). Value of supply chain resilience: Roles of culture, flexibility, and integration. *International Journal of Physical Distribution & Logistics Management*, *50*(1), 80–100. https://doi.org/10.1108/IJPDLM-02-2019-0041

Dhaigude, A. S., Kapoor, R., Gupta, N., & Padhi, S. S. (2021). Linking supply chain integration to supply chain orientation and performance – a knowledge integration perspective from Indian manufacturing industries. *Journal of Knowledge Management*, *25*(9), 2293–2315. https://doi.org/10.1108/JKM-01-2020-0064

Dhamija, P., & Bag, S. (2020). Role of artificial intelligence in operations environment: A review and bibliometric analysis. *The TQM Journal*, *32*(4), 869–896. https://doi.org/10.1108/TQM-10-2019-0243

Freije, I., De La Calle, A., & Ugarte, J. V. (2022). Role of supply chain integration in the product innovation capability of servitized manufacturing companies. *Technovation*, *118*, 102216. https://doi.org/10.1016/j.technovation.2020.102216

Helo, P., & Hao, Y. (2022). Artificial intelligence in operations management and supply chain management: An exploratory case study. *Production Planning & Control*, *33*(16), 1573–1590. https://doi.org/10.1080/09537287.2021.1882690

Huo, B., Ye, Y., Zhao, X., & Zhu, K. (2019). Supply chain quality integration: A taxonomy perspective. *International Journal of Production Economics*, *207*, 236–246. https://doi.org/10.1016/j.ijpe.2016.05.004

Jajja, M. S. S., Chatha, K. A., & Farooq, S. (2018). Impact of supply chain risk on agility performance: Mediating role of supply chain integration. *International Journal of Production Economics*, *205*, 118–138. https://doi.org/10.1016/j.ijpe.2018.08.032

Jambulingam, T., & Kathuria, R. (2020). Antecedents to buyer-supplier coordination in the pharmaceutical supply chain. *International Journal of Pharmaceutical and Healthcare Marketing*, *14*(2), 289–303. https://doi.org/10.1108/IJPHM-08-2019-0058

Kaplan, A., & Haenlein, M. (2020). Rulers of the world, unite! The challenges and opportunities of artificial intelligence. *Business Horizons*, *63*(1), 37–50. https://doi.org/10.1016/j.bushor.2019.09.003

Kim, S. Y., & Kim, J. (2025). The impact of AI recommendation quality on service satisfaction: The moderating roles of standardization and customization. *Journal of Services Marketing*, *39*(4), 365–386. https://doi.org/10.1108/JSM-05-2024-0214

Leoni, L., Ardolino, M., El Baz, J., Gueli, G., & Bacchetti, A. (2022). The mediating role of knowledge management processes in the effective use of artificial intelligence in manufacturing firms. *International Journal of Operations & Production Management*, *42*(13), 411–437. https://doi.org/10.1108/IJOPM-05-2022-0282

Liu, C.-L., & Lee, M.-Y. (2018). Integration, supply chain resilience, and service performance in third-party logistics providers. *The International Journal of Logistics Management*, *29*(1), 5–21. https://doi.org/10.1108/IJLM-11-2016-0283

Liu, S., Tan, J., Mao, H., & Gong, Y. (2021). Does national culture matter? Understanding the impact of supply chain integration in multiple countries. *Supply Chain Management: An International Journal*, *26*(5), 610–628. https://doi.org/10.1108/SCM-03-2020-0099

Mukherjee, S., Baral, M. M., Nagariya, R., Chittipaka, V., & Pal, S. K. (2024). Artificial intelligence-based supply chain resilience for improving firm performance in emerging markets. *Journal of Global Operations and Strategic Sourcing*, *17*(3), 516–540. https://doi.org/10.1108/JGOSS-06-2022-0049

Munir, M., Jajja, M. S. S., Chatha, K. A., & Farooq, S. (2020). Supply chain risk management and operational performance: The enabling role of supply chain integration. *International Journal of Production Economics*, *227*, 107667. https://doi.org/10.1016/j.ijpe.2020.107667

Nayal, K., Raut, R., Priyadarshinee, P., Narkhede, B. E., Kazancoglu, Y., & Narwane, V. (2022). Exploring the role of artificial intelligence in managing agricultural supply chain risk to counter the impacts of the COVID-19 pandemic. *The International Journal of Logistics Management*, *33*(3), 744–772. https://doi.org/10.1108/IJLM-12-2020-0493

Nenavani, J., & Jain, R. K. (2022). Examining the impact of strategic supplier partnership, customer relationship and supply chain responsiveness on operational performance: The moderating effect of demand uncertainty. *Journal of Business & Industrial Marketing*, *37*(5), 995–1011. https://doi.org/10.1108/JBIM-10-2020-0461

Paesano, A. (2023). Artificial intelligence and creative activities inside organizational behavior. *International Journal of Organizational Analysis*, *31*(5), 1694–1723. https://doi.org/10.1108/IJOA-09-2020-2421

Panahifar, F., Byrne, P. J., Salam, M. A., & Heavey, C. (2018). Supply chain collaboration and firm's performance: The critical role of information sharing and trust. *Journal of Enterprise Information Management*, *31*(3), 358–379. https://doi.org/10.1108/JEIM-08-2017-0114

Rajaguru, R., & Matanda, M. J. (2019). Role of compatibility and supply chain process integration in facilitating supply chain capabilities and organizational performance. *Supply Chain Management: An International Journal*, *24*(2), 301–316. https://doi.org/10.1108/SCM-05-2017-0187

Serrano-Torres, G. J., Lopez-Orange, A. L., Larrea-Square, P. L., & Mazon-Fierro, G. (2025). Transformation of the dairy supply chain through artificial intelligence: A systematic review. *Sustainability*, *17*(3), 982. https://doi.org/10.3390/su17030982

Shukor, A. A. A., Newaz, Md. S., Rahman, M. K., & Taha, A. Z. (2021). Supply chain integration and its impact on supply chain agility and organizational flexibility in manufacturing firms. *International Journal of Emerging Markets*, *16*(8), 1721–1744. https://doi.org/10.1108/IJOEM-04-2020-0418

Siagian, H., Ronni Basana, S., Jiwa Husada Tarigan, Z., Novitasari, M., & Jie, F. (2024). The role of supply chain management in improving the competitive advantage of Indonesian small and medium enterprises. *Problems and Perspectives in Management*, *22*(2), 696–707. https://doi.org/10.21511/ppm.22(2).2024.54

Sundram, V. P. K., Chhetri, P., & Bahrin, A. S. (2020). The Consequences of Information Technology, Information Sharing and Supply Chain Integration, towards Supply Chain Performance and Firm Performance. *Journal of International Logistics and Trade*, *18*(1), 15–31. https://doi.org/10.24006/jilt.2020.18.1.015

Tan, H.-C., Soh, K. L., Wong, W. P., & Tseng, M.-L. (2022). Enhancing supply chain resilience by counteracting the Achilles heel of information sharing. *Journal of Enterprise Information Management*, *35*(3), 817–846. https://doi.org/10.1108/JEIM-09-2020-0363

Tarigan, Z. J. H., Maer, M. N. D., Malelak, M. I., Basana, S. R., Siagian, H., & Nasir, Z. A. B. (2025). Implementation of artificial intelligence project, quality internal and external supply chain integration, responsiveness for operational performance in manufacturing. *Journal of Project Management*, *10*(4), 689–702. https://doi.org/10.5267/j.jpm.2025.8.002

Tarigan, R.S., Tarigan, Z.V.B., Maer, M.N.D., Tarigan, Z.J.H., & Ferry Jie, F. (2024). The influence of information technology on supply chain resilience through purchasing strategy, production flexibility, and supply chain responsiveness. *Decision Science Letters*, 13(4), 791-806, DOI: 10.5267/j.dsl.2024.9.001

Tran, S. N. (2025). Business performance of family firms: Exploring the roles of knowledge management, innovation and competitive advantage. *Journal of Family Business Management*, 15 (6), 1621–1644. https://doi.org/DOI 10.1108/JFBM-01-2025-0004

Wamba-Taguimdje, S.-L., Fosso Wamba, S., Kala Kamdjoug, J. R., & Tchatchouang Wanko, C. E. (2020). Influence of artificial intelligence (AI) on firm performance: The business value of AI-based transformation projects. *Business Process Management Journal*, *26*(7), 1893–1924. https://doi.org/10.1108/BPMJ-10-2019-0411

Wang, S., & Zhang, H. (2025). Enhancing environmental, social, and governance performance through artificial intelligence supply chains in the energy industry: Roles of innovation, collaboration, and proactive sustainability strategy. *Renewable Energy*, *245*, 122855. https://doi.org/10.1016/j.renene.2025.122855

Younis, H., Sundarakani, B., & Alsharairi, M. (2022). Applications of artificial intelligence and machine learning within supply chains:systematic review and future research directions. *Journal of Modelling in Management*, *17*(3), 916–940. https://doi.org/10.1108/JM2-12-2020-0322

Yu, W., Chavez, R., Jacobs, M., Wong, C. Y., & Yuan, C. (2019). Environmental scanning, supply chain integration, responsiveness, and operational performance: An integrative framework from an organizational information processing theory perspective. *International Journal of Operations & Production Management*, *39*(5), 787–814. https://doi.org/10.1108/IJOPM-07-2018-0395

Yuan, Y., Liu, L., & Liu, L. (2022). How does information integration enhance SMEs' credit quality: The mediating role of supply chain capabilities. *Industrial Management & Data Systems*, *122*(2), 544–561. https://doi.org/10.1108/IMDS-10-2020-0621

© 2026 by the authors; licensee Growing Science, Canada. This is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (http://creativecommons.org/licenses/by/4.0/).