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Real-Time Supply Chain Visibility: Key Determinants and their Impact on Modern Retail Performance

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Abstract. This study investigates key drivers influencing real-time supply chain visibility and their impact on supply chain performance in the modern retail business. The objectives are: (1) to identify the causal factors that influence real-time supply chain visibility and supply chain performance in modern retail business, 2) to analyze the impact of the causal factors of supply chain performance through the mediating role of real-time supply chain visibility within the modern retail business, and 3) to develop marketing strategies based on the causal factors of supply chain performance through the mediating role of real-time supply chain visibility within the modern retail business. Data were gathered through structured interviews and online questionnaires, and analyzed using descriptive, inferential, and content analysis methods. The findings reveal that process integration, predictive data management, and digital logistics significantly enhance real-time supply chain visibility. These factors also indirectly improve supply chain performance through the mediating role of visibility. Additionally, real-time visibility itself has a direct positive impact on performance. The study offers strategic insights for modern retail business, highlighting the importance of operational integration, predictive analytics, and digital logistics technologies in enhancing visibility and overall supply chain effectiveness.

1. INTRODUCTION

In today's dynamic and competitive business environment, the retail sector in Thailand is facing intensified pressure from both domestic and international competitors. The emergence of new players and the rapid growth of e-commerce platforms have significantly disrupted traditional retail operations. As consumer preferences shift toward digital convenience, modern retailers must adapt quickly by embracing new technologies and innovative business models. This strategic adaptation is essential not only for sustaining customer engagement but also for ensuring long-term business growth and competitiveness. One of the most critical challenges facing modern retail business is the ability to deliver high-quality service in terms of speed, safety, and convenience. These factors have become primary determinants of customer satisfaction and market success. In response, many retailers are shifting their focus toward digital transformation strategies, particularly by integrating e-commerce with physical operations and leveraging platforms tailored to their products and target customers. Within this context, real-time supply chain visibility (RTSCV) has emerged as a key enabler of agile, responsive, and customer-centric supply chains.

RTSCV refers to the capability of businesses to monitor supply chain operations continuously, detect disruptions early, and make timely decisions based on accurate and accessible data. It enhances transparency and coordination across various supply chain partners and has been shown to significantly improve supply chain performance (SCP), which includes reducing costs, improving delivery speed, eliminating inefficiencies, and meeting customer expectations. Studies by Zhang et al. (2019), Zhang et al. (2021), and Saleheen and Habib (2022) underscore the positive impact of RTSCV on supply chain agility and resilience, especially in retail and e-commerce settings. To explore these dynamics in the Thai retail context, this study focuses on five categories of modern retail business: grocery stores, specialty stores, convenience stores, supermarkets, and department stores. Data collection was carried out between August and October 2023, employing both qualitative and quantitative research methods. The qualitative phase involved in-depth interviews with five business owners, each representing a different retail category, to gain insights into strategic practices and technological adoption.

For the quantitative phase, data were gathered through structured online questionnaires distributed to 620 modern retail business across Thailand. The sample size was determined based on the requirements for structural equation modeling (SEM), which was employed to analyze the relationships among key variables. The data analysis included descriptive statistics, inferential statistics, and qualitative content analysis to ensure a comprehensive understanding of the findings. This study aims to identify and validate the core factors that influence RTSCV and assess how these factors indirectly affect SCP. The primary components investigated include process integration, predictive data management, and digital logistics. Findings from this research are expected to provide practical recommendations for modern retail business seeking to enhance visibility, responsiveness, and performance throughout their supply chain networks.

In addition to practical implications, the research contributes to academic knowledge by offering a conceptual model that links digital transformation elements with real-time visibility and performance outcomes. Scholars, practitioners, and policymakers can use the insights to further explore supply chain innovations, enhance teaching in logistics and supply chain management, and support the evolution of Thailand's retail industry in the digital age.

2. RESEARCH OBJECTIVE

1. To identify the causal factors that influence real-time supply chain visibility and supply chain performance in modern retail business.
2. To analyze the impact of the causal factors of supply chain performance through the mediating role of real-time supply chain visibility within the modern retail business.

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3. To develop marketing strategies based on the causal factors of supply chain performance through the mediating role of real-time supply chain visibility within the modern retail business.

3. LITERATURE REVIEW

The theoretical foundation of this research integrates several key concepts, including process integration, predictive data management, digital logistics, real-time supply chain visibility, and supply chain performance. These concepts, previously discussed in the background and problem statement, serve as the core variables used to frame the research model. The study explores the interrelationships among these variables to understand how they collectively influence supply chain efficiency in the modern retail context.

Hypothesis 1: There is a significant relationship between process integration and real-time supply chain visibility.

Lafkihi et al. (2024) surveyed 157 managers from various French industries to examine the impact of Industry 4.0 technologies on supply chain performance. The findings revealed that while advanced technologies alone did not directly enhance performance, their benefits were realized through improved integration and visibility. This underscores the mediating role of process integration and real-time visibility in achieving superior supply chain outcomes.

Wang et al. (2024) presented a model where supply chain integration capability comprises visibility, agility, and flexibility. The authors argue that process integration is foundational for achieving supply chain visibility, as it enables synchronized operations and real-time information sharing among partners. The study highlights that without integrated processes, achieving the level of visibility required for agile and flexible supply chain responses is challenging.

Mullapudi (2025) explored how real-time data integration platforms have transformed supply chain operations. The study highlights that the convergence of advanced technologies, robust implementation strategies, and comprehensive data governance frameworks enables organizations to achieve unprecedented levels of efficiency, visibility, and control. This emphasizes the critical role of process integration in facilitating real-time supply chain visibility.

Hypothesis 2: There is a significant relationship between process integration and supply chain performance mediated by real-time supply chain visibility.

Kim and Lee (2019) demonstrated that process integration positively influences supply chain outcomes through enhanced supply chain visibility. They argue that real-time visibility enables firms to monitor, control, and optimize supply chain activities continuously, which mediates the effect of integrated processes on performance improvements.

Lafkihi et al. (2024) found that Industry 4.0 technologies significantly improve supply chain performance when mediated by process integration and real-time visibility. Their empirical study of 157 managers in French industry highlighted that visibility and integration are key to leveraging the benefits of digital technologies in supply chains.

Tive (2024) reported in its "State of Visibility 2024" that 75% of supply chain professionals view real-time visibility as a top priority in digital transformation. The report underscores that improved visibility facilitates better integration and leads to enhanced supply chain performance.

Hypothesis 3: There is a significant relationship between predictive data management and real-time supply chain visibility.

Li et al. (2024) emphasized the crucial role of effective data governance and management in operations and supply chain contexts. The authors argue that robust data practices are foundational for enabling predictive analytics, which in turn enhances real-time visibility across supply chains.

HSO Report (2024) underscored the transformative impact of predictive analytics and AI on supply chain operations. It reveals that organizations integrating predictive data management strategies experience enhanced real-time visibility, allowing them to anticipate disruptions and adapt swiftly to market changes.

Zheng and Brintrup (2024) introduced a Generative AI-enhanced machine learning framework designed to improve supply chain visibility. By leveraging predictive data management techniques, the study demonstrates how relationship prediction within knowledge graphs can uncover hidden connections, thereby facilitating more informed decision-making in supply chain management.

Hypothesis 4: There is a significant relationship between predictive data management and supply chain performance mediated by real-time supply chain visibility.

Adewola et al. (2024) explored the role of predictive analytics in optimizing supply chain resilience. They demonstrate that integrating predictive data management with real-time visibility tools allows organizations to anticipate disruptions, adapt proactively, and maintain high performance levels in volatile environments.

Oyewole et al. (2024) highlighted how predictive analytics enhances supply chain management by improving demand forecasting, inventory optimization, and overall visibility. The authors emphasize that real-time visibility, enabled by predictive data management, leads to more informed decision-making and improved supply chain performance.

Rebello (2024) discussed how predictive analytics empowers businesses to anticipate supply chain disruptions and optimize operations. By leveraging real-time data, companies can enhance visibility across their supply chains, leading to improved performance and resilience.

Hypothesis 5: There is a significant relationship between digital logistics and real-time supply chain visibility.

Freichel et al. (2022) stated that complex supply chains are a characteristic of today's economic life, which is defined by uncertainty and risk. Successfully managing these requires the development of flexible structures and processes that adapt based on information transparency, which enables better decision-making.

Macron (2024) explored how the integration of Artificial Intelligence (AI), the Internet of Things (IoT), and SAP solutions has revolutionized supply chain management. The study highlights that these technologies enable real-time data analytics and automated decision-making, leading to enhanced end-to-end visibility across the supply chain. By integrating these digital tools, organizations can optimize production cycles, reduce waste, and respond dynamically to market fluctuations.

Wang et al. (2024) introduced a three-stage circular model encompassing visibility, agility, and flexibility as core components of supply chain integration (SCI). The authors emphasize that enhancing supply chain visibility is the foundational step in this model, enabling organizations to understand customer needs and market dynamics effectively. This visibility facilitates agility and flexibility, allowing firms to respond swiftly to changes and reconfigure operations as needed.

Hypothesis 6: There is a significant relationship between digital logistics and supply chain performance mediated by real-time supply chain visibility.

Info-Tech Research Group (2024) emphasized the importance of real-time transportation visibility systems in optimizing logistics operations. By providing immediate insights into shipment statuses, these systems enhance operational reliability and

customer satisfaction, thereby improving overall supply chain performance.

Tive (2024) found that 89% of supply chain professionals prioritize digital transformation, with 75% identifying real-time visibility as a key component. The adoption of IoT devices for real-time shipment tracking more than doubled from 25% in 2023 to 53% in 2024, underscoring the growing recognition of visibility's role in enhancing supply chain performance.

TVS Supply Chain Solutions (2024) discussed how integrating real-time visibility with dynamic demand forecasting enhances logistics efficiency. This integration allows for better inventory management and responsiveness to market changes, leading to improved supply chain performance.

Hypothesis 7: There is a significant relationship between real-time supply chain visibility and supply chain performance.

Mecalux (2024) outlined the benefits of real-time supply chain visibility, including improved decision-making, greater profitability, better inventory management, enhanced customer satisfaction, optimized transportation routes, and sustainability. Real-time data allows logistics managers to make informed decisions and react swiftly to changes, leading to cost reductions and decreased waste.

Perfect Planner (2024) discussed how integrating real-time tracking technologies, such as AI, machine learning, and 5G connectivity, enhances supply chain visibility. Companies like Unilever and PepsiCo have leveraged these technologies to reduce stockouts by 12%, decrease inventory carrying costs by 15%, and improve service levels by up to 30%.

RedCloud Technology (2025) emphasized that real-time visibility transforms supply chains into dynamic systems capable of preempting disruptions, responding to volatile demand, and streamlining complexity. This enhanced visibility directly impacts financial performance by reducing waste, optimizing routes, and reallocating resources effectively.

4. RESEARCH FRAMEWORK

This research is qualitative and quantitative research. The researcher defines the research conceptual framework according to the systems concept/theory, whereby the researcher can conclude that the components of the system consist of (1) Input, (2) Process, (3) Output, and (4) Feedback, which can be explained as follows:

(1) Input means Process Integration, consisting of 4 components: 1) Process Synthesis, 2) Process Analysis, 3) Optimal Process, 4) Data Quality Defining; Predictive Data Management consists of 9 components: 1) Communication, 2) Decision Making, 3) Predictive Behavior, 4) Visualization, 5) Scoring, 6) Patterns, 7) Machine Learning, 8) Consumer Behavior, 9) Statistical Model; Digital Logistics consists of 10 components: 1) Transportation, 2) Inventory Management, 3) Order Processing, 4) Information Management, 5) Financial Management, 6) Warehouse Management, 7) Material Handling, 8) Purchasing, 9) Packaging, 10) Demand Management.

(2) Process refers to Real-Time Supply Chain Visibility, consisting of 3 components: 1) Planning, 2) Scheduling, 3) Execution.

(3) Output refers to Supply Chain Performance, consisting of 5 components: 1) Reliability, 2) Responsiveness, 3) Agility, 4) Assets, 5) Supply Chain Cost.

(4) Feedback refers to Supply Chain Performance, which is an output factor that has a feedback effect on Process Integration, Predictive Data Management, and Digital Logistics.

All 4 components are interrelated and cannot function without one another. A change in one component must affect other components. Defects or errors in one component will lead to deficiencies in other components as well. The details are as follows:

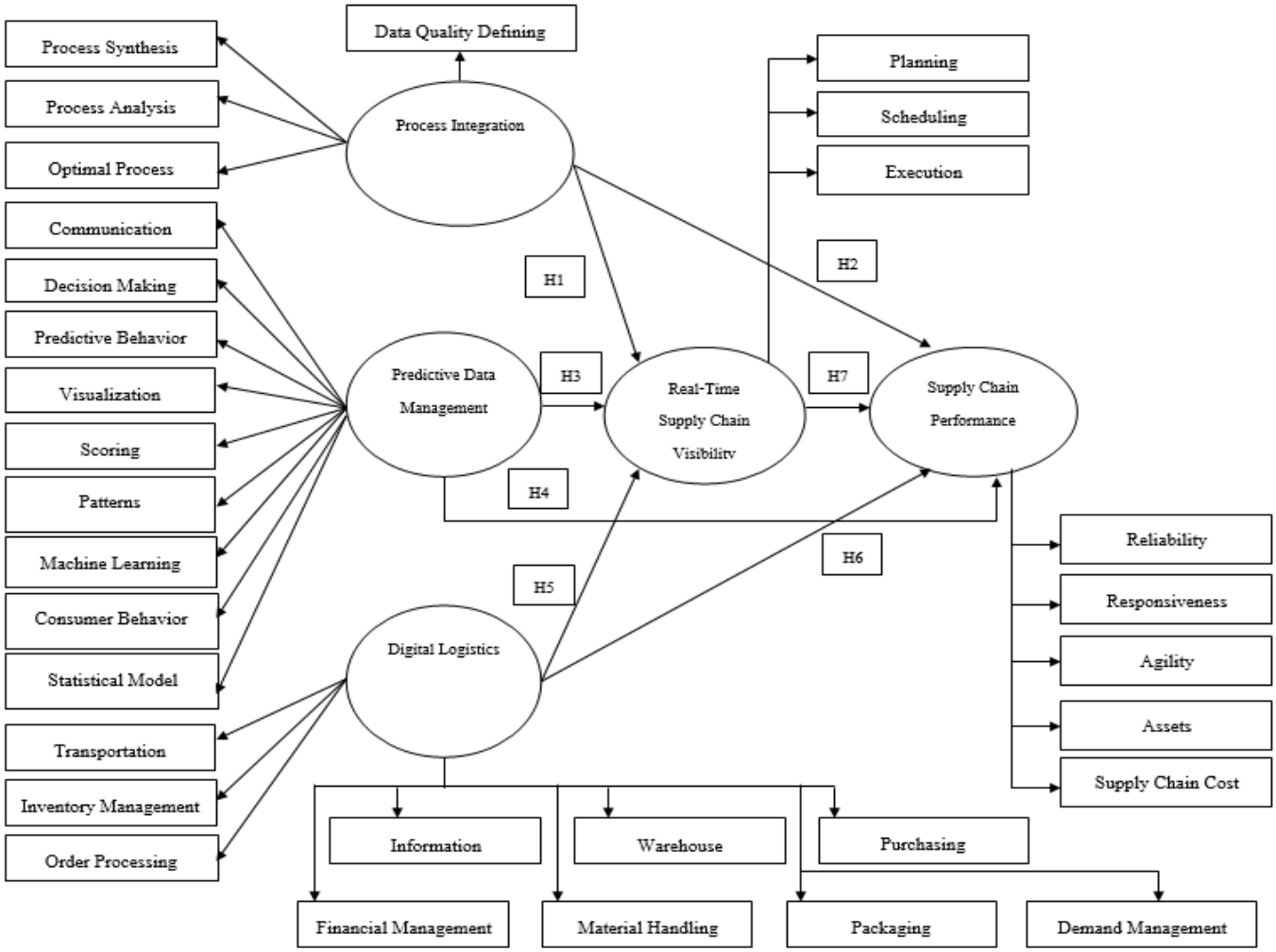

Figure 1: Research Framework

5. RESEARCH METHODOLOGY

This research employs a mixed-methods approach. The research area focuses on collecting data from the modern retail business, which is categorized into five types: 1) Grocery Stores, 2) Specialty Stores, 3) Convenience Stores, 4) Supermarkets, and 5) Department Stores.

The population consists of 7,685 modern retail businesses, based on corporate data from the Department of Business Development (2022). The sample includes 620 modern retail business, selected using Structural Equation Modelling (SEM) techniques. Based on the research framework, there are 5 latent variables and 31 observed variables. According to statistical guidance from Hair et al. (2006), the appropriate sample size for multivariate analysis should range between 15 to 20 times the number of observed variables, making the suitable sample size range from 465 (15 x 31) to 620 (20 x 31).

The research instruments consist of two types:

1) A questionnaire, which includes: Part 1: Personal and organizational demographic information of respondents, Part 2: Items related to Process Integration, Part 3: Items related to Predictive Data Management, Part 4: Items related to Digital Logistics, Part 5: Items related to Real-Time Supply Chain Visibility, Part 6: Items related to Supply Chain Performance.

The researcher submitted a draft of the questionnaire to five experts for evaluation of content validity using the Item-Objective Congruence (IOC) method, resulting in an IOC score of 0.8691. The reliability of the research instrument was tested and yielded a Cronbach's alpha of 0.9491. This tool was used to study the causal factors of Real-Time Supply Chain Visibility and its impact on Supply Chain Performance in the context of the modern retail business.

2) Interview: The interview included the following questions:

- What is your opinion on the overall Process Integration of modern retail business, and what factors does it impact?
- Do you think modern retail business should adopt Predictive Data Management to enhance Real-Time Supply Chain Visibility? If so, what factors does it affect?
- What is your opinion on the overall Digital Logistics practices in modern retail business, and what are the impacted factors?
- Overall, how are Process Integration, Predictive Data Management, and Digital Logistics related?
- Does your organization consider Real-Time Supply Chain Visibility, and if so, in what way?
- In your opinion, which variables directly or indirectly affect Real-Time Supply Chain Visibility, and how?
- Do you believe Real-Time Supply Chain Visibility directly influences Supply Chain Performance? If so, how?

The researcher conducted in-depth interviews by visiting the participants between August and September 2023, and analyzed and synthesized the data through descriptive narration and content analysis in order to support the development of the model derived from the quantitative phase.

6. RESEARCH FINDINGS

Table 1 summarizes the research findings for both objectives. Respondents reported a high level of agreement across all five constructs, with top-rated components including Process Analysis, Decision Making, and Purchasing. Structural equation modeling revealed that Process Integration, Predictive Data Management, and Digital Logistics positively influence Real-Time Supply Chain Visibility and Supply Chain Performance. Real-Time Supply Chain Visibility also significantly enhances performance. Additionally, all three causal factors have indirect effects on performance through visibility, confirming its mediating role. All findings are statistically significant.

Table 1: Research findings.

Objective 1	**Research findings**
Process integration	Respondents had a high level of opinion regarding overall Process Integration. When analyzed by individual components, all four aspects were also rated at a high level. Among them, the highest-rated aspect was Process Analysis, followed by Optimal Process, Data Quality Defining, and Process Synthesis.
Predictive data management	Respondents had a high level of opinion regarding overall Predictive Data Management. When considered by all nine components, all were rated at a high level. The highest-rated aspect was Decision Making, followed by Patterns, Predictive Behavior, Statistical Model, Visualization, Scoring, Communication, Machine Learning, and Consumer Behavior.
Digital logistics	Respondents had a high level of opinion regarding overall Digital Logistics. Among the ten components, two were rated at the highest level, and eight at a high level. The most highly rated aspect was Purchasing, followed by Packaging, Warehouse Management, Material Handling, Order Processing, Inventory Management, Demand Management, Financial Management, Information Management, and Transportation.
Real-time supply chain visibility	Respondents had a high level of opinion regarding overall Real-Time Supply Chain Visibility. All three components were also rated at a high level. Among them, Execution was rated highest, followed by Scheduling and Planning.
Supply chain performance	Respondents had a high level of opinion regarding overall Supply Chain Performance. Among the five components, one was rated at the highest level, and four at a high level. The most highly rated component was Assets, followed by Supply Chain Cost, Reliability, Agility, and Responsiveness.
Objective 2	**Research findings**
Process integration (PCI)	Has a positive direct influence on Real-Time Supply Chain Visibility (RTSCV) with a direct effect size of 0.15, which is statistically significant at the 0.01 level.
Process integration (PCI)	Has a positive direct influence on Supply Chain Performance (SCP) with a direct effect size of 0.21, which is statistically significant at the 0.01 level.
Predictive data management (PDM)	Has a positive direct influence on Real-Time Supply Chain Visibility (RTSCV) with a direct effect size of 0.58, which is statistically significant at the 0.01 level.
Predictive data management (PDM)	Has a positive direct influence on Supply Chain Performance (SCP) with a direct effect size of 0.09, which is statistically significant at the 0.01 level.
Digital logistics (DGL)	Has a positive direct influence on Real-Time Supply Chain Visibility (RTSCV) with a direct effect size of 0.13, which is statistically significant at the 0.05 level.
Digital logistics (DGL)	Has a positive direct influence on Supply Chain Performance (SCP) with a direct effect size of 0.22, which is statistically significant at the 0.01 level.
Real-time supply chain visibility (RTSCV)	Has a positive direct influence on Supply Chain Performance (SCP) with a direct effect size of 0.55, which is statistically significant at the 0.01 level.
Process integration (PCI), predictive data management (PDM), and digital logistics (DGL)	Have positive indirect influences on Supply Chain Performance (SCP) through Real-Time Supply Chain Visibility (RTSCV), with indirect effect sizes of 0.08, 0.11, and 0.32, respectively. These indirect effects are statistically significant at the 0.01 level.

Objective 3: To develop marketing strategies based on the causal factors of supply chain performance through the mediating role of real-time supply chain visibility within the modern retail business.

Based on quantitative research using structural equation modeling (SEM), it was found that process integration, predictive data management, and digital logistics have a statistically significant influence on supply chain performance at the 0.01 level. Moreover, real-time supply chain visibility has both direct and indirect effects on improving supply chain performance. These model-based findings serve as a foundation for developing proactive marketing strategies grounded in situation analysis and linked with both classic and strategic marketing tools.

In terms of internal and external factor analysis, the SWOT analysis highlighted key strengths such as high process integration and advanced digital logistics systems, which contribute to enhanced real-time supply chain visibility and operational efficiency. However, challenges remain in achieving seamless data synchronization and integration across various platforms. Opportunities exist in the form of technological advancements that can further enhance real-time visibility, offering the potential for quicker response times and better customer experience management. Conversely, strong competition from other retailers leveraging similar technologies and potential regulatory challenges regarding data privacy pose threats. The PESTEL analysis revealed that economic factors, such as fluctuating logistics costs, and technological factors, like advancements in digital logistics, greatly impact supply chain efficiency. Furthermore, social factors such as consumer demand for faster delivery times and transparent tracking information drive the need for better visibility, while environmental and legal factors could influence how supply chain practices evolve.

The marketing goals are clearly defined, focusing on enhancing customer satisfaction through accurate, real-time information

on inventory and order status, increasing brand loyalty through transparent communication and reliable order fulfillment, and expanding market share by leveraging superior supply chain performance as a differentiator. In terms of segmentation, the target market consists of customers who prioritize fast and reliable delivery services, particularly middle-income consumers seeking cost-effective yet dependable retail solutions. The project is positioned as "A modern retail experience powered by real-time supply chain visibility, ensuring fast, reliable, and transparent services."

The 7Ps marketing strategy emphasizes a competitive pricing approach, leveraging operational efficiencies from improved supply chain visibility and predictive analytics. It integrates both online and offline sales channels, allowing customers to track product availability and delivery status in real-time. The promotion strategy includes a mix of digital marketing campaigns and content that highlights the company's use of real-time supply chain visibility, while well-trained customer service teams ensure accurate responses based on real-time data. Streamlined order fulfillment processes, supported by real-time tracking, enhance overall operational efficiency, and the digital platform offers customers live supply chain data, providing transparency during the entire order process.

For strategy implementation, quarterly action plans with allocated budgets for technology investments and marketing initiatives will be developed. Key performance indicators (KPIs) such as on-time delivery rates, real-time inventory accuracy, and customer satisfaction scores will be used to monitor and adjust strategies in response to market changes and technological advancements. This strategy focuses on agility, allowing the business to adapt to shifts in consumer behavior or supply chain disruptions, ensuring long-term sustainable growth within the modern retail business by leveraging the mediating role of real-time supply chain visibility to enhance supply chain performance and customer satisfaction.

7. DISCUSSION

The findings from Objective 1 and 2 reveal that:

- Process integration ensures that different functions work in harmony, facilitating smooth data flow across the supply chain. This allows for real-time tracking of inventory, orders, and deliveries, enhancing supply chain visibility. Essentially, process integration is the foundation for achieving efficient real-time supply chain visibility, aligning with Mullapudi's (2025) study.
- Process integration plays a crucial role in improving supply chain performance by enabling real-time supply chain visibility. It smoothly coordinates various operational functions and ensures seamless data flow across the supply chain. This allows retailers to access accurate inventory, order, and delivery information on time. This transparency helps retailers anticipate potential issues, identify bottlenecks, and make informed decisions instantly, ultimately leading to improved supply chain performance, aligning with Tive's (2024) study.
- Predictive data management enhances real-time supply chain visibility by leveraging advanced analytics to predict future trends and customer behavior. By analyzing large volumes of real-time data, predictive models provide insights into demand patterns, market trends, and potential disruptions, enabling retailers to proactively adjust inventory levels, optimize order fulfillment processes, and mitigate risks. This ensures a more responsive and agile supply chain, and ultimately improves real-time supply chain visibility and overall supply chain performance, aligning with Zheng and Brintrup's (2024) study.
- Predictive data management directly enhances supply chain performance by utilizing real-time supply chain visibility. By analyzing real-time data, predictive models forecast demand patterns, market trends, and potential disruptions, helping retailers adjust inventory levels proactively, optimize order fulfillment, and reduce risks. This results in a more agile and responsive supply chain. In summary, predictive data management improves supply chain performance through its direct impact on real-time supply chain visibility, enabling timely decision-making to enhance overall efficiency and effectiveness, aligning with Rebello's (2024) study.
- Digital logistics enhances real-time supply chain visibility by leveraging technology to provide accurate and up-to-date information on the movement of goods. By digitizing logistics processes, retailers can track shipments, monitor inventory levels, and optimize transportation routes in real-time. This increased visibility allows retailers to identify issues, track performance metrics, and make data-driven decisions instantly, leading to a more responsive and efficient supply chain. Essentially, digital logistics has a direct impact on real-time supply chain visibility by providing the infrastructure and tools necessary to track and manage logistics operations effectively, aligning with Wang et al.'s (2024) study.
- Digital logistics directly improves supply chain performance by enabling real-time supply chain visibility. By leveraging technology, digital logistics provides accurate and up-to-date information on the movement of goods. This visibility allows retailers to optimize transportation routes, track shipments, and monitor inventory levels in real-time, resulting in improved performance and responsiveness. Essentially, digital logistics facilitates decision-making and better operational efficiency, ultimately enhancing supply chain performance through its direct impact on real-time visibility, aligning with TVS Supply Chain Solutions' (2024) study.
- Real-time supply chain visibility directly improves supply chain performance by providing accurate and up-to-date information on inventory levels, order statuses, and potential disruptions. With real-time insights, retailers can make data-driven decisions, optimize operations, and respond quickly to demand or supply changes. This visibility enhances coordination between supply chain partners, faster order fulfillment, and proactive problem-solving, resulting in improved efficiency and customer satisfaction. Essentially, real-time supply chain visibility enables retailers to identify opportunities for optimization and risk reduction, driving overall supply chain performance, aligning with RedCloud Technology's (2025) study.

8. RESEARCH CONTRIBUTION

Based on the research findings, this study provides academic insights into the causal factors influencing real-time supply chain visibility that affect supply chain performance in the context of modern retail business. The results enhance understanding of the relationships and impacts among variables related to real-time supply chain visibility and supply chain performance. These findings can be further developed and applied in academic research across other areas. Additionally, the research enables modern retail business to enhance process integration in order to improve real-time supply chain visibility and overall supply chain performance, based on predictive data management and the promotion of digital logistics. These insights offer practical implications for improving operational efficiency and effectiveness.

9. CONCLUSION

The retail landscape has shifted toward modern retail formats, reducing dependence on wholesalers. Modern retail business, often large investors with extensive branch networks, possess significant bargaining power over manufacturers and distributors due to their position as major buyers. These businesses employ systematic retail management, advanced transportation systems, and, in many cases, modern distribution centers, while leveraging various technologies to gain competitive advantages. Data for this study was collected from modern retail operators through online questionnaires and in-depth interviews. The analysis found that process integration, predictive data management, and digital logistics each have positive effects on real-time supply chain visibility and supply chain performance. Moreover, real-time supply chain visibility significantly enhances supply chain performance. Therefore, modern retail business can utilize these insights to develop strategic approaches in process integration, predictive data management, and digital logistics to strengthen their competitive edge.

10. RECOMMENDATION

Future research should apply the causal relationship model of real-time supply chain visibility and its effect on supply chain performance among modern retail business to verify whether the model is consistent with empirical data. Moreover, future studies should explore additional key factors that may serve as causal variables of real-time supply chain visibility affecting supply chain performance in the context of modern retail business, since there are still several relevant variables that were not included in the current study. Examples of such factors include:

- Supply Chain Mapping: This involves the process of documenting data exchange between companies, suppliers, and stakeholders across the supply chain to build a global network of supply relationships.
- Leverage Technology: This refers to finding ways to utilize technology to improve organizational and individual efficiency by skillfully applying modern resources and incorporating technology to support business activities.
- Invest in Employee Training: Investment in staff training increases profitability by reducing costs through benefits such as lower employee turnover and fewer penalties from non-compliance. Training also helps generate additional revenue through accelerated sales growth and improved productivity.
- Monitor Progress: Tracking progress enables early detection of potential problems, allowing for timely intervention and continued operational success

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