

Causal Factors of Real Time Supply Chain Visibility Affecting the Supply Chain Performance in the Modern Retail Business

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Abstract

This article aimed: 1) to study the causal factors affecting real time supply chain visibility and supply chain performance, 2) to study the influence of causal factors of real time supply chain visibility affecting the supply chain performance in the modern retail business, and 3) construct a model of the causal factors of real time supply chain visibility affecting the supply chain performance in the modern retail business. The tools used for data collection were selected by interview forms and online questionnaires. The instrument for collecting data was descriptive statistics and inferential statistics. Analysis data was made by descriptive statistics and content analysis. The research results were found as follows; process integration affects real time supply chain visibility, process integration affects supply chain performance through real time supply chain visibility, predictive data management affects real time supply chain visibility, predictive data management affects supply chain performance through real time supply chain visibility, digital logistics affects real time supply chain visibility, digital logistics affects supply chain performance through real time supply chain visibility, and real time supply chain visibility affects supply chain performance. Therefore, modern retail businesses can use the research findings to develop strategies for process integration, predictive data management, and digital logistics to gain a competitive advantage for their businesses.

Keywords: Process Integration, Predictive Data Management, Digital Logistics, Real Time Supply Chain Visibility, Supply Chain Performance

1. Introduction

The business competition is intensifying due to new competitors both domestically and internationally, who see opportunities for growth in the Thai retail sector, including competitors from online stores. This growth is rapid, prompting entrepreneurs to swiftly adjust their strategies to expand revenue and customer base in the long term. Retailers are shifting towards online sales, including food and consumer goods. Consequently, retail entrepreneurs must expedite their review and adjustment of strategies towards online markets, selecting platforms suitable for their products and capable of meeting the needs of their target customers. Quality of service, including convenience, security, and fast delivery, is a key factor in business competition and may be a crucial point for future retail business operations. This has led researchers to study real-time supply chain visibility, which may impact supply chain performance. Supply chain performance refers to the efficiency of each stage of the e-commerce supply chain, including cost adjustment, reducing inefficiencies, improving speed, and meeting customer expectations. Research on real-time supply chain visibility has been conducted by Zhang et al. (2019); Zhang et al. (2021); Saleheen and Habib (2022).

1.1 Background and Importance of the Problem

Researchers collected data from modern retail business operators, categorizing them into the following types: 1) Grocery Stores, 2) Specialty Stores, 3) Convenience Stores, 4) Supermarkets, and 5) Department Stores. Data collection involved interviews and online questionnaires with modern retail business operators from August 2566 to October 2566. The sample size for qualitative research was 5 participants, corresponding to the categorized types of retail businesses. Meanwhile, for quantitative research, the sample size was 620 modern retail business operators, determined through statistical analysis of the data using structural equation modeling techniques.

The anticipated benefits include enabling modern retail business operators to integrate predictive data analytics and digital logistics to enhance real-time supply chain visibility and improve supply chain performance. The research findings can be used as insights for decision-making and business development, promoting business success and advancing the retail sector in Thailand. Furthermore, it aims to advance the management systems of modern retail businesses, promoting real-time supply chain visibility and enhancing supply chain performance in the Thai context.

This research article presents a study that applies systems theory to develop and examine the perceptual variables influencing real-time supply chain visibility and supply chain performance. The researchers believe that the findings of this study are significant for modern retail businesses, as well as academically beneficial for scholars, researchers, and students to further develop and expand upon in future academic endeavors.

1.2 Research Question

Research questions derived from reviewing concepts, theories, and relevant studies:

1) What are the causal factors influencing real-time visibility in the supply chain and supply chain performance in modern retail businesses?

2) How do the causal factors influencing real-time visibility in the supply chain and supply chain performance in modern retail businesses?

3) What is the model of the causal factors of real-time visibility in the supply chain affecting supply chain performance in modern retail businesses like?

1.3 Research Objective

The research objectives are as follows:

1. To study the causal factors influencing real-time visibility in the supply chain and supply chain performance in modern retail businesses?

2. To examine the influence of the causal factors influencing real-time visibility in the supply chain and supply chain performance in modern retail businesses?

3. To develop a model of the causal factors of real-time visibility in the supply chain affecting supply chain performance in modern retail businesses like?

2. Literature Review

2.1 Related Concepts and Theories

The literature review encompasses concepts and theories such as process integration, predictive data analytics, digital logistics, real-time supply chain visibility, and supply chain performance, as outlined in the background and significance of the problem, which serve as variables for framing the research.

2.2 Literature Surveys

2.2.1 The Relationship between Process Integration and Real-Time Supply Chain Visibility

Hulstijn et al. (2012) suggested that compliance with trade regulations can be improved by facilitating electronic document exchange to enhance supply chain visibility. A crucial aspect for accepting the concept of supply chain visibility is trust in the reliability of data, which depends on both data integrity (no illegal data alterations) and product flow integrity (no unauthorized additions or removals of products). The challenge lies in determining how these integrity concepts are interconnected.

Baah et al. (2021) assessed the significant role of data sharing in supply chains, emphasizing its impact on supply chain visibility, collaboration, agility, and overall supply chain performance. The study proposed that data sharing, supply chain visibility, collaboration, and agility collectively have significant direct and indirect influences on supply chain performance.

Al-Khatib et al. (2022) examined the relationship hypothesized between the Internet of Things (IoT) and Big Data Analytics (BDA) with Supply Chain Visibility (SCV) and

Operational Performance (OP) in the pharmaceutical sector in Jordan. The article aimed to test a conceptual model related to the environmental impact of SCV to achieve its objectives. The conceptual model was developed through a review of current literature, and data analysis was conducted by building a structural equation model using Amos 25 software, examining goodness-of-fit, discriminant validity, reliability, and confirmatory factor analysis.

2.2.2 The Relationship between Process Integration and Supply Chain Performance through Real-Time Supply Chain Visibility

Firmansyah and Siagian (2022) investigated the impact of data sharing on supply chain performance through supplier quality management, supply chain agility, and supply chain innovation. They collected data using a Likert 7-point scale questionnaire distributed via Google Form, email, WhatsApp, and postal mail.

Nguyen and Hoang (2022) demonstrated the influence of IT on the performance of the tourism supply chain in Vietnam. They presented the level of impact through "data sharing" and "electronic data interchange." The research data were gathered from 154 tourism companies, both domestic and international. The study employed Structural Equation Modeling (SEM) to prove the positive impact of IT on data sharing and electronic data interchange, which helps enhance the supply chain's performance.

Prodhan et al. (2023) emphasized the increasing importance of supply chain management in the fisheries industry due to heightened global competition and complexities arising from the diverse interests of stakeholders and the fragmented market structures. Their study provided comprehensive insights into the existing gaps in the literature for measuring supply chain performance.

2.2.3 The Relationship between Predictive Data Management and Real-Time Supply Chain Visibility

Patrick et al. (2022) introduced predictive analytics within the framework of supply chain management to enhance decision-making at Kenya Power and Lighting Company in Kenya. The study aimed to assess the existing predictive analytics in supply chain management, analyze the current supply chain management system in the utility company in Kenya, and develop an integrated predictive analytics framework for large-scale data in supply chain management for decision-making in the energy and lighting company in Kenya.

Pradhan et al. (2022) surveyed and analyzed the impact of predictive analytics on supply chain management. Predictive analytics is expanding, and many organizations are utilizing this technology for improved benefits and profitability. Supply chains consist of various components that can embed this technology to enhance overall performance.

Shashi et al. (2022) examined the role of big data analytics in improving supply chain performance. Big data technology in the pharmaceutical supply chain enables supplies chain managers to have visibility from the source to the destination. Additionally, it aids in demand forecasting, automated systems, enhancing predictive maintenance capabilities, and protecting the integrity of the pharmaceutical supply chain from counterfeit drugs.

2.2.4 The relationship between Predictive Data Management and Supply Chain Performance through Real-Time Supply Chain Visibility

Xiang et al. (2021) highlighted the growing interest in big data analytics across various companies globally. The significant impact of big data analytics on global companies has brought new opportunities for data-driven decision-making processes, which are revolutionizing industries and business functions. Big data analytics has immense potential to enhance supply chain performance in the logistics industry.

Cadden et al. (2022) examined the impacts of environmental dynamics and competitive pressures on supply chain analytics configuration. They explored how the Indeterminate Supply Chain Analytics Capability (ISCAC) filters the relationships between Big Data Characteristics (BDCs) and Supply Chain Agility (SCAG) to support improved Supply Chain Performance (SCP).

Udayabhanu and George (2022) analyzed supply chain management data, focusing on traditional supply chain operations and the implications when information technology is integrated into traditional supply chains. The article also covered inventory management and the Bullwhip Effect's impact on supply chain management.

2.2.5 The Relationship between Digital Logistics and Real-Time Supply Chain Visibility

Freichel et al. (2022) emphasized that today's supply chains are characterized by complexity, uncertainty, and risk. Successfully managing these factors requires the development of flexible structures and processes that adapt to the transparency of data, enabling better decision-making.

Kalaiarasan et al. (2022) noted that Supply Chain Visibility (SCV) has gained recognition in recent years as a key factor for analyzing and improving supply chain performance. However, the level of SCV utilization still lags behind current technological advancements.

Singagerda et al. (2022) identified the impact of supply chain visibility on business performance, determining the effects of supply chain flexibility on business operations, and assessing the impact of supplier development on business performance.

2.2.6 The Relationship between Digital Logistics and Supply Chain Performance through Real-Time Supply Chain Visibility

Hye et al. (2020) investigated factors related to the structure of companies in adopting blockchain in logistics supply chains (LSC). Besides, it also mentioned the relationship between company IT capabilities, service quality of employees, and e-logistics in the performance of LSC. Additionally, this study constructed a theoretical model and demonstrated the impact of implementing blockchain on the performance of logistics supply chains (LSCP).

Ji (2022) stated that cross-border e-commerce (CBEC) has developed rapidly in recent years, with continuous new formats in both cross-border and domestic circuit

development in the post-pandemic era. CBEC will play an increasingly important role and take on responsibilities in changing international trade and driving domestic economic growth.

Liu (2022) emphasized that a sustainable logistics supply chain capability is crucial for the sustainable development of agricultural product logistics. From this information, this paper proposes methods to enhance the capability of agricultural product logistics supply chain governance in the digital economy era using newly improved genetic algorithm algorithms.

2.2.7 The Relationship between Real-Time Supply Chain Visibility and Supply Chain Performance

Saqib (2021) addressed the research gap in the literature and raised the question of whether the sustainability performance of manufacturing companies could be improved through sustainable practices by using the appropriate impact of supply chain perspectives (a comprehensive learning, perception, and coordination perspective), product complexity, and product modularity.

Singagerda et al. (2022) identified the impact of supply chain visibility on business performance to determine the impact of supply chain flexibility on business performance and to determine the impact of supplier development on business performance.

Tan et al. (2022) examined the relationship between blockchain integration in the supply chain (SCI) and supply chain performance (SCP) in the era of Digital Transformation (DT) in Malaysia's semiconductor industry to provide clarity on this emerging area. Seventy-one conveniently sampled managers from operations and supply chain departments affiliated with semiconductor manufacturing companies in Malaysia were invited to participate in the survey.

2.3 Conceptual Framework

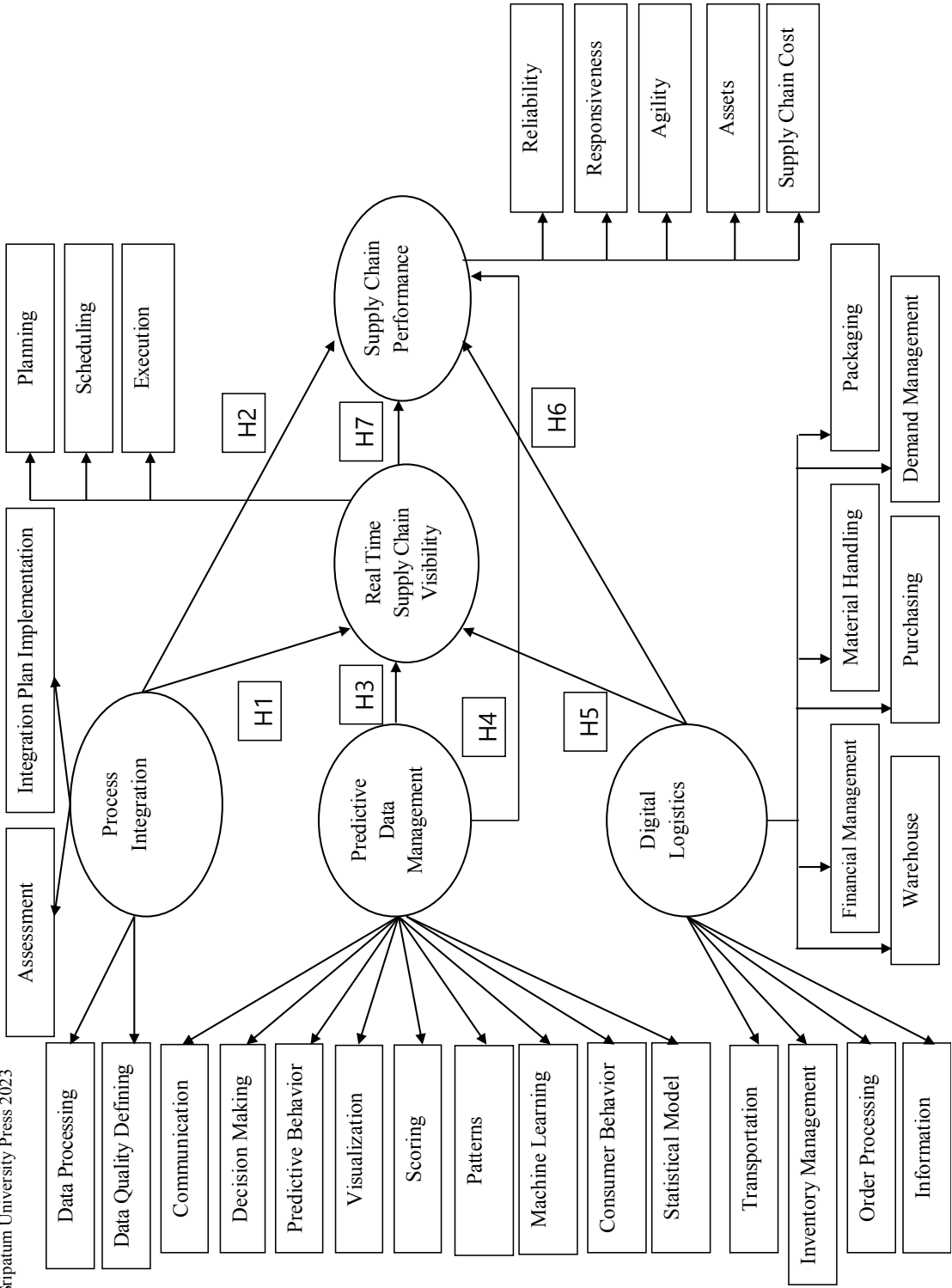
This research is a qualitative and quantitative study. Researchers established a research framework based on system theory, where they can summarize the components of the system as follows:

Inputs consist of the following components: 1) process integration, including assessment, integration plan implementation, data processing, and data quality defining; 2) predictive data management, including communication, decision making, predictive behavior, visualization, scoring, patterns, machine learning, consumer behavior, and statistical model, and 3) digital logistics, including transportation, inventory management, order processing, information management, financial management, warehouse management, material handling, purchasing, packaging, and demand management.

Processes include immediate supply chain visibility, which consists of planning, scheduling, and execution.

Outputs represent supply chain performance, including reliability, responsiveness, agility, assets, and supply chain cost.

Feedback refers to supply chain performance, which as output factors, have feedback effects on process integration, predictive data management, and digital logistics. All four components are interrelated, and the absence of any component will affect the others. Changes in one component will affect others. Deficiencies or errors in one component will impact others as well.



2.4 Research Hypothesis

Hypothesis 1: Process integration affects real-time supply chain visibility.

Hypothesis 2: Process integration affects supply chain performance through real-time supply chain visibility.

Hypothesis 3: Predictive data management affects real-time supply chain visibility.

Hypothesis 4: Predictive data management affects supply chain performance through real-time supply chain visibility.

Hypothesis 5: Digital logistics affects real-time supply chain visibility.

Hypothesis 6: Digital logistics affects supply chain performance through real-time supply chain visibility.

Hypothesis 7: Real-time supply chain visibility affects supply chain performance.

3. Research Methodology

3.1 Research Design

This research is a mixed-method study. The research area involves collecting data from modern retail business operators, categorized as follows: 1) grocery stores, 2) specialty stores, 3) convenience stores, 4) supermarkets, and 5) department stores.

3.2 Population and Sample

The population consists of new era retail business operators, totaling 7,685 entities (Corporate data, Department of Business Development, 2022). The sample group comprises 620 new era retail business operators selected using statistical technique, Structural Equation Modeling (SEM). The research framework includes 5 latent variables and 31 observed variables. Statisticians recommend that the sample size should be between 15 to 20 times the numbers of observed variables (Hair et al., 2006). Therefore, an appropriate and sufficient sample size for multivariate analysis should range from $15 \times 31 = 465$ to $20 \times 31 = 620$.

3.3 Research Instruments

3.3.1 Questionnaire

Part 1: Related to personal data and general information about the respondents' organizations.

Part 2: Related to process integration.

Part 3: Related to predictive data management.

Part 4: Related to digital logistics.

Part 5: Related to real-time supply chain visibility.

Part 6: Related to supply chain performance.

3.3.2 Interview Guide

1) How do you perceive the overall process integration of new era retail business operators? What are the impacts?

2) Do you think new era retail business operators should apply predictive data management to enhance immediate supply chain visibility? What are the impacts?

3) How would you describe the digital logistics of new era retail business operators? What are the impacts?

4) Overall, how are process integration, predictive data management, and digital logistics related?

5) Does your organization consider immediate supply chain visibility? In what aspects?

6) To enhance immediate supply chain visibility, what variables do you think have direct and indirect impacts? How?

7) Do you think immediate supply chain visibility directly affects supply chain performance? How?

3.4 Data Collection

The researchers collected data through in-depth interviews conducted between August and September 2021. After analyzing and synthesizing the data, they wrote a descriptive narrative, including content analysis, to develop the model derived from quantitative analysis.

3.5 Statistics Used for Data Analysis

The researchers conducted an analysis to determine the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test to assess the suitability of variables and components before conducting the confirmatory factor analysis. The KMO value should be greater than 0.5, and Bartlett's Test should be less than 0.05 to proceed with the confirmatory factor analysis. This process helps confirm that the components identified from the literature review and questionnaire data collection are consistent with and adequately measure the latent variables.

4. Data Analysis and Findings

4.1 Introduction

This study was designed using structural equation modeling (SEM) analysis to assess the goodness-of-fit of the model derived from the literature review and empirical data. The researchers evaluated the model fit with the empirical data, considering various indices,

including Chi-Square, χ^2/df , CFI, GFI, AGFI, RMSEA, and SRMR, to assess the congruence between the model and the empirical data.

4.2 Data Analysis of the Qualitative Data

The research findings led to the development of a model derived from exploratory and confirmatory analysis. The researchers named this model the Real-Time Visibility for Supply Chain Performance Model, abbreviated as the RTVSCM Model.

4.4 Summary of the Results

The process integration affected real-time visibility in the supply chain, and Hypothesis 1 was accepted.

The process integration affected supply chain performance through real-time visibility in the supply chain, and Hypothesis 2 was accepted.

The predictive data management affected real-time visibility in the supply chain, and Hypothesis 3 was accepted.

The predictive data management affected supply chain performance through real-time visibility in the supply chain, and Hypothesis 4 was accepted.

The digital logistics affected real-time visibility in the supply chain, and Hypothesis 5 was accepted.

The digital logistics affected supply chain performance through real-time visibility in the supply chain, and Hypothesis 6 was accepted.

The real-time visibility in the supply chain affected supply chain performance, and Hypothesis 7 was accepted.

5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

The overarching theme of the article is the transformation of retail formats into modern retailing, reducing dependence on wholesalers. Business operators tend to be major capitalists with extensive branch networks, often acting as large buyers, thus wielding negotiation power over manufacturers or distributors. Systematic store management, transport system management, and some having modern distribution centers are observed. Various technologies are employed to gain marketing advantages. Data was collected from modern retail business operators through online questionnaires and in-depth interviews. The analysis concludes that process integration affects real-time supply chain visibility and performance, predictive data management affects real-time supply chain visibility and

performance, digital logistics affects real-time supply chain visibility and performance, and real-time supply chain visibility affects supply chain performance. Therefore, modern retail business operators can utilize research findings to develop strategies in process integration, predictive data management, and digital logistics to enhance competitiveness.

5.2 Discussion

The research findings suggest that from the in-depth interviews, a causal relationship model of real-time supply chain visibility affecting supply chain performance can be developed. The research results provide academic insights into explaining the causal factors of real-time supply chain visibility affecting supply chain performance from modern retail business operators. This research enables a deeper understanding of the relationships impacting various variables related to real-time supply chain visibility and supply chain performance. These findings can be further developed and applied in academic studies and in various practical applications. Moreover, the research results enable modern retail business operators to create process integration to enhance real-time supply chain visibility and supply chain performance based on predictive data management and digital logistics. This allows operators to improve operational efficiency and effectiveness.

5.3 Recommendation

In the next research, it is advisable to utilize the causal relationship model of real-time supply chain visibility affecting supply chain performance from modern retail business operators. This will help verify the model's alignment with subsequent empirical data. Additionally, the next research should explore other important causal factors of real-time supply chain visibility influencing supply chain performance from modern retail business operators. Many factors have not been studied yet, such as: supply chain mapping that is a processes for compiling data within companies, suppliers, and stakeholders in a company's supply chain to create a global network of supply chain connections. Leveraging technology is exploring ways to use technology to enhance organizational and individual efficiency, utilizing up-to-date resources proficiently, and employing technology to aid in work activities. Moreover, investing in employee training can increase profits by reducing expenses, manifested in benefits such as decreased turnover or fewer penalties due to non-compliance. Training can also boost revenue through accelerated sales growth and increased productivity. Monitoring progress is tracking progress that helps anticipate and address problems early, allowing for timely solutions and continued operations.

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