

**INFLUENCE OF ERP SYSTEM AND DEMAND AND SUPPLY  
ENVIRONMENTS ON SUPPLY CHAIN PERFORMANCE WITH  
INFORMATION INTEGRATION AND INFORMATION CAPABILITIES**

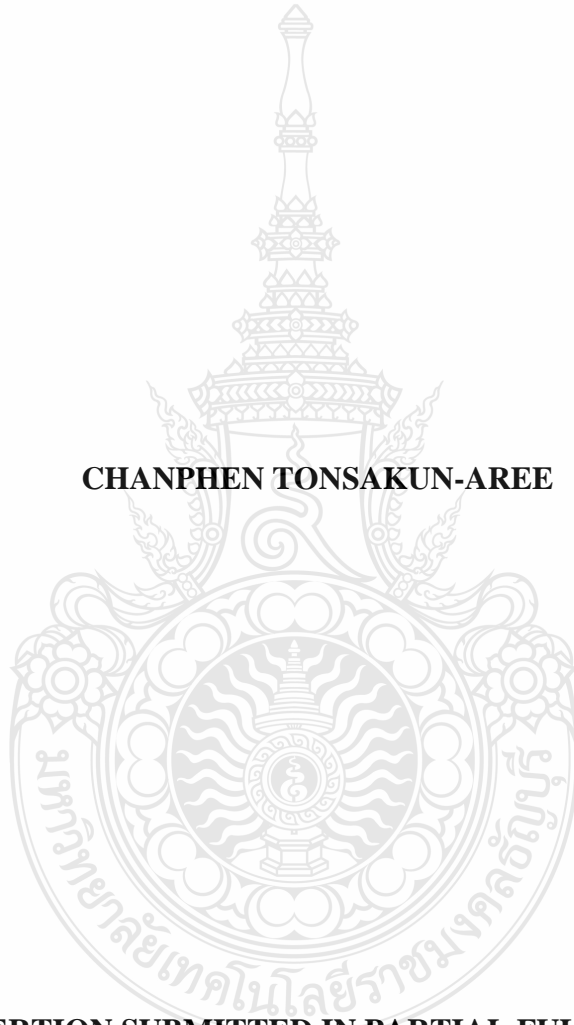
**CHANPHEN TONSAKUN-AREE**



**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF  
PHILOSOPHY PROGRAM IN BUSINESS ADMINISTRATION  
RAJAMANGALA UNIVERSITY OF TECHNOLOGY THANAYABIRI  
ACADEMIC YEAR 2021  
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**Dissertation Title** Influence of ERP System and Demand and Supply  
Environments on Supply Chain Performance with  
Information Integration and Information Capabilities  
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**Program** Business Administration  
**Dissertation Advisor** Assistant Professor Natnarong Jaturat, Ph.D.  
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**Academic Year** 2021

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January 20, 2022

<b>หัวข้อขุณินิพนธ์</b>	อิทธิพลของระบบอีอาร์พีและสภาพแวดล้อมของอุปสงค์และอุปทานต่อประสิทธิภาพห่วงโซ่อุปทานด้วยการบูรณาการสารสนเทศและความสามารถของสารสนเทศ
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<b>ปีการศึกษา</b>	2564

### บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษา 1) ระบุถึงการจัดการระบบสารสนเทศภายใต้บริบทของทฤษฎีมุมมองฐานทรัพยากรเพื่อความสามารถในการปฏิบัติงานในระบบโซ่อุปทาน 2) การรับรู้ถึงประโยชน์ของการบูรณาการสารสนเทศและความสามารถของสารสนเทศในระบบของโซ่อุปทาน 3) ตรวจสอบความสัมพันธ์ของการบูรณาการสารสนเทศและความสามารถของสารสนเทศของสภาพแวดล้อมของอุปสงค์และอุปทานในระบบอีอาร์พีและผลการดำเนินงาน 4) สืบหาว่าการบูรณาการสารสนเทศและความสามารถของสารสนเทศอำนวยความสะดวกต่อระบบอีอาร์พีอย่างไร และ 5) สืบหาว่าปัจจัยของการบูรณาการสารสนเทศและความสามารถของสารสนเทศที่เป็นตัวแปรส่งผ่านที่มีผลกระทบต่อผลการดำเนินงานของโซ่อุปทานของอุตสาหกรรมอาหารแช่แข็งของประเทศไทย

การวิจัยนี้เป็นการวิจัยเชิงปริมาณโดยใช้วิเคราะห์ด้วยเทคนิคสมการโครงสร้างเพื่อแสดงน้ำหนักผลกระทบระหว่างตัวแปรในกรอบการวิจัย กลุ่มตัวอย่างที่ใช้ในการศึกษา ได้แก่ บริษัทผลิตแปรรูปอาหารแช่แข็งของประเทศไทยจำนวน 234 บริษัท โดยใช้แบบสอบถามสอบถามจากผู้บริหารเป็นตัวแทนของกิจการ และใช้การสัมภาษณ์เชิงลึกจากผู้บริหารจำนวน 5 กิจการ เพื่อยืนยันผลที่ได้จากการวิจัยเชิงปริมาณ

ผลการวิจัยพบว่า สารสนเทศจากระบบอีอาร์พีและสภาพแวดล้อมของอุปสงค์และอุปทานมีผลกระทบต่อผลการบูรณาการสารสนเทศและความสามารถของสารสนเทศ การบูรณาการสารสนเทศและความสามารถของสารสนเทศเป็นตัวกลางในการส่งผ่านผลกระทบจากระบบอีอาร์พีและสภาพแวดล้อมของอุปสงค์และอุปทานไปสู่ผลการดำเนินงานโซ่อุปทานที่ดี จากผลการวิจัย แสดงให้เห็นว่าบริษัทในอุตสาหกรรมอาหารแช่แข็งจะต้องมีการนำข้อมูลที่ได้จากสภาพแวดล้อม ของอุปสงค์และอุปทานและจากระบบอีอาร์พีมาบูรณาการเพื่อให้สารสนเทศมีความครอบคลุมในทุกแผนกงาน

และจัดเก็บข้อมูลให้ทันต่อเวลา มีความถูกต้อง โดยใช้ระบบจัดการฐานข้อมูลเพื่อสนับสนุนการตัดสินใจในการปฏิบัติงานให้เกิดเป็นความสามารถของสารสนเทศ ความสามารถการบูรณาการสารสนเทศและความสามารถของสารสนเทศจะช่วยส่งผลกระทบต่อผลปฏิบัติงานและสนับสนุนต่อการดำเนินงานที่ดีในด้านโซ่อุปทาน

**คำสำคัญ:** ระบบ ERP สภาพแวดล้อมของอุปสงค์และอุปทาน การบูรณาการสารสนเทศ ความสามารถของสารสนเทศ ประสิทธิภาพของห่วงโซ่อุปทาน



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<b>Academic Year</b>	2021

### ABSTRACT

This research aimed to study: 1) the management of information systems, in the context of resource-based perspective theory, in the field of information integration and information capabilities; 2) to develop the appropriate and perceived usefulness of information integration and information capabilities in the supply chain system; 3) to examine the relative significance between information integration and information capabilities of demand and supply environments in ERP systems and supply chain performance of the food processing industry in Thailand; 4) to investigate how information integration and information capabilities facilitate ERP system capabilities; and 5) to investigate the effects of information integration and information capabilities as mediators and their impact on supply chain performance of the frozen food industry in Thailand.

Quantitative research, using structural equation model techniques were used to examine the regression weight between variables in a research framework. The sample group used in the study consisted of 234 frozen food manufacturing or processing companies in Thailand and their executives who each completed a questionnaire. Moreover, in-depth interviews were conducted with executives from five businesses to confirm the results of the quantitative research.

The study results showed that information from the ERP system and the demand and supply environment had an impact on information integration and information capabilities. Information integration and information capabilities are a means for

transmitting the effects of the ERP system and the demand and supply environment to good supply chain performance. The findings show that companies in the frozen food industry should integrate information from the demand and supply environments with the ERP system to provide comprehensive information across all departments and to store information in a timely manner, using a database management system to support operational decision-making, to become an information capability. Information integration and information capability will support supply chain operations with good performance based on flexible and reliable information.

**Keywords:** ERP system, demand and supply environment, information integration, information capabilities, supply chain performance

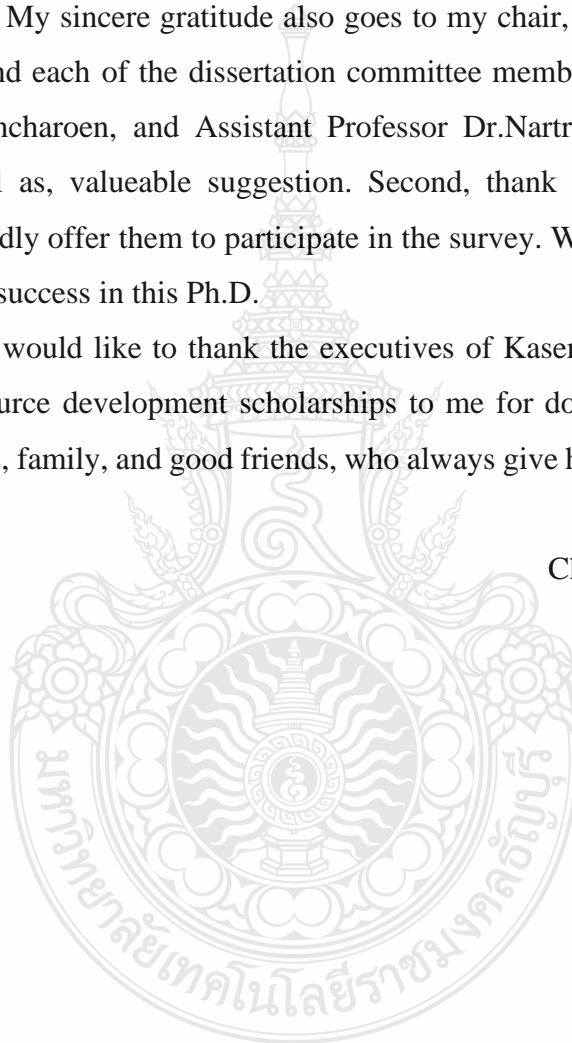


## Acknowledgements

This is my acknowledge those who helped me with this dissertation. First important, I would like to express my deepest appreciation and sincere to my advisor, Assistant Professor Dr.Natnarong Jaturat for counitues guidance, unfailing support, and my co-advisor, Associate Professor Chanongkorn kuntonbutr for his expertise for advise in this dissertation, My sincere gratitude also goes to my chair, Associate Professor Dr. Veera Boonjing, and each of the dissertation committee members, Associate Professor Dr.Somchai Prakancharoen, and Assistant Professor Dr.Nartraphee Tancho for their comments, as well as, valueable suggestion. Second, thank you to the mention all executives who kindly offer them to participate in the survey. Without their support, my study will not be a success in this Ph.D.

Finally, I would like to thank the executives of Kasem Bundit University for giving human resource development scholarships to me for doctoral study, Moreover, thank to my parents, family, and good friends, who always give help and encouragement.

Chanphen Tonsakun-Aree





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# CHAPTER 1

## INTRODUCTION

### **1.1 Background and Statement of the Problem**

Thailand has a natural resource that is a complete food source that is trusted by consumers around the world. Frozen food and ready meals with food of Thailand has a tendency to produce and preserve food that can be developed into ready-to-eat foods.

The world frozen food business market represents the leading segment of the processed food business, accounting for more than 41% of the overall market in terms of value. Technavio's analysts forecast the global frozen food market to grow at a CAGR (Compound Annual Growth Rate) of 6.15% during the period 2017-2021. This report covers the present scenario and the growth prospects of the global frozen food market for 2017-2021. To calculate the market size, the report considers the revenue generated through the sales of frozen foods sold to individual customers as well as to foodservice customers through various retail outlets, which include, but are not limited to, hypermarkets, supermarkets, convenience stores, independent retailers, discount stores, warehouse clubs, and online channel.

Food and agricultural production in Thailand play an indispensable role in economic growth. The frozen industry is considered to be important due to its increasing annual exports. The results show that the majority of these manufacturers in the supply chain are efficient. The frozen export industry in Thailand, competition is likely to intensify as a result of globalization, which makes trade freer and more open. Supply chain management (SCM) has emerged as the core strategy to build competitive advantage in this business, both nationally and at the local level (Chaowarat & Shi, 2013). Which corresponds to Chaowarat, Wanitwattanakosol, and Sopadang (2009) Frozen food industries play an important role for the economic growth in Thailand because of the product quality is accepted in developed countries such as Japan and European Union. Frozen food industrial sectors effort has been spent in the improvement of internal efficiency, aiming at cost reduction, better quality, on time delivery and competitiveness. Furthermore, Salin and Nayga Jr (2003) They examine the business relationships in the cold chain used for exporting food. The cold chain services are closely



related to quality and potentially affect the availability of outsourced cold chain services. In addition, Setthasakko (2007) this study is to gain a clearer understanding of key determinants that drive frozen food industry sustainability, it should focus on demand and supply environmental and social sustainability and perspective of the seafood supply chain.

Therefore, Food Supply Chain Management has evolved into a high tech robust end-to-end distribution system with an increasing emphasis on customer satisfaction. So, the effective Supply Chain Management (SCM) is taken as a tool for combating fierce competition, cutting cost and improving economic performance (Noomhorm & Ahmad, 2008).

From research on frozen food that has been studied Frozen food plays an important role in the lives of Thai people and the world. With the everyday life of the market, the market for frozen food products is growing rapidly.

Therefore, the frozen food industry of Thailand, it must accelerate its development throughout the supply chain within the industry. The integration of information obtained from the operational processes in the various departments of the Enterprise Resources Planning System in each organization, that will support the decision making of the executive to forecasting the demand and supply of the food chain in frozen food industry. In addition, Enterprise Resource Planning is a system that interrelates business processes and business success together, depending on the expertise of each department. If the organization can utilize the Resources Based View (RBV) theory to information integration and information capabilities, it will effect of using resources increasing to the competitive advantage. Thus, RBV theory is collections of resource information such as sources, data of demand and supply environment of the food chain in Enterprise Resource Planning system of the frozen food industry in Thailand and effects of using resources on the competitive advantage. This includes the management of activities and information resources of each department. It can be linked to the system in real time to support the process. The main business has been very successful implementing the enterprise resource planning system in a timely manner and demand and supply environment in the economy. It is a database for analysis and synthesis together with relevant information in each situation. It will contribute to the information

integration of all internal and external departments of the enterprise, which is involved in the management of the organization's operational processes, which will enable efficient management of the supply chain. When the supply chain performance more successful, this will enhance the quality of communication for the business and manage time for better and faster transportation process. Moreover, this can be increasing the value added to the product and service. Therefore, the researcher wants to study, if all departments of the enterprise are involved in information gathering, the information integration needs of the demand and supply environment and integration capabilities with core function and business processes will enhance the comparison.

The results of this research will benefit the Thai frozen food industry in the field of information integration and capabilities which is the demand and supply environment will be importance to create the information system for decision support system to analyze to information of all departments for improving on quality and supply chain performance of the frozen food industry in Thailand.

## **1.2 Purpose of the Study**

**1.2.1.** To identify the Resource Based Views (RBV) perspective as an empirical for management information capabilities to operating in the supply chain system.

**1.2.2.** To develop appropriate and perceived usefulness of information integration and information capabilities in the supply chain system.

**1.2.3.** To examine the relative significant between information integration and information capabilities of demand and supply environment in ERP system and supply chain performance of the food processing industry in Thailand.

**1.2.4.** To investigate how information integration and information capabilities facilitate the ERP System capabilities.

**1.2.5.** To investigate the effects of information integration and information capabilities as the mediator and the impact on supply chain performance with the frozen food industry in Thailand.

## 1.3 Research Questions and Hypotheses

### 1.3.1 Research Questions

- 1) Do ERP System and Demand and Supply Environment affect the Supply Chain Performance through Information Integration?
- 2) Do ERP System and Demand and Supply Environment affect the Supply Chain Performance through Information Capability?
- 3) How ERP System and Demand and Supply Environment affect the Supply Chain Performance through Information Capability and Information Integration?

### 1.3.2 Hypotheses

This study the hypothesis test is performed as follows.

H1: ERP System has positive effect to Information Capability.

H2: ERP System has positive effect to Information Integration.

H3: Demand and Supply Environment has positive effect to Information Capability.

H4: Demand and Supply Environment has positive effect to Information Integration.

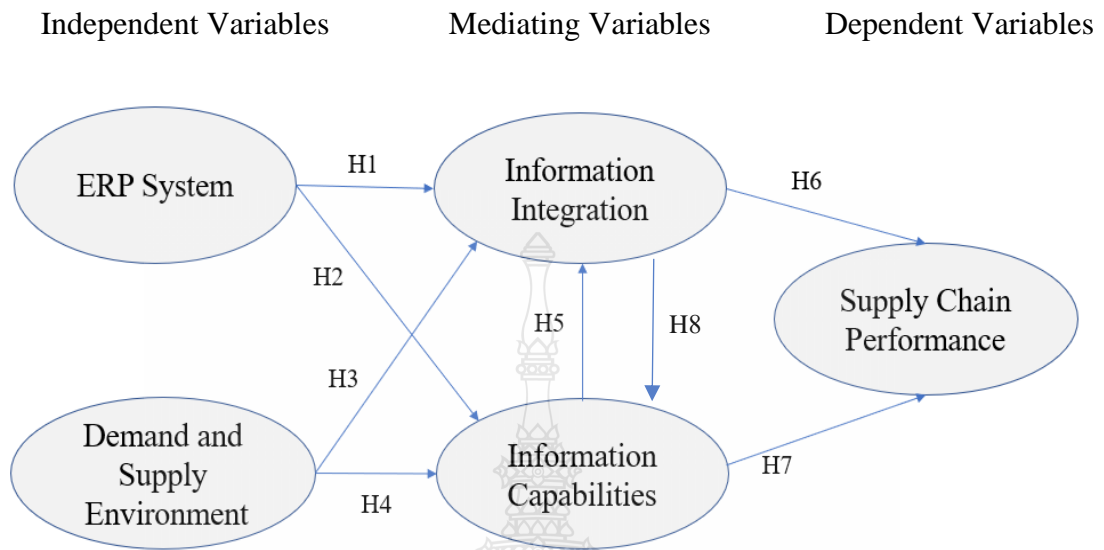
H5: Information Capability has positive effect to Information Integration.

H6: Information Integration has positive effect to Supply Chain Performance.

H7: Information Capability has positive effect to Supply Chain Performance.

H8: Information Integration has positive effect to Information Capability

## 1.4 Research Framework



**Figure 1.1** Research Framework

## 1.5 Definitions of Terms

### 1.5.1 Frozen food

Frozen food is a ready-to-eat food, after passing the defrosting or cooking process. Using cold to maintain food quality to maintain freshness, fresh food or freshly prepared food by making vegetables, fruits, meats or cooking for ready-to-eat food such as processed products etc. (The food processing for food preservation by reducing the temperature of the food to below -18 degrees celsius at all times in order to maintain the quality of the microbial increase and the prevention of recrystallization of ice. Which is a major cause of quality deterioration.)

### 1.5.2 ERP system

Soh, Kien, and Tay-Yap (2000) said that Enterprise Resource Planning refers to the overall resource planning of an enterprise in order to utilize organization's resources to achieve maximum benefits. ERP is a tool for managing business to solve the problems within organization, assist in management, investment planning, and efficient management of all corporate resources.

### **1.5.3 Demand and Supply Environment**

Complexity of Demand and Supply variations encourages new synthesis efforts in order to adapt to the changing environment of the economy and consumption of the market, Supply must be ready to change the demand for tracking and adaptation (Kokko et al., 2017). Therefore, supply chain network with distribution centers and retailers need to model to solve the problem with big data and use the information provided in the system to solve problems in depth (Diabat, Dehghani, & Jabbarzadeh, 2017).

### **1.5.4 Information Integration**

Information Integration can be achieved by using IT techniques for coordination between vendors, facilitating interaction between vendors and customers. (Demand-side and supply side) and reduce transaction costs (Yang & Maxwell, 2011).

### **1.5.5 Information Capabilities**

Information Capabilities is an information quality that includes beliefs, ability to interpret reputation, reputation, value added, integrity, objectivity, reliability, safety, timeliness, price, validation, availability, time respond. So, the information capabilities of an organization use to increase the profits and the performances of the operating system and management system in each organization.

### **1.5.6 Supply Chain Performance**

Supply Chain Performance is meet the needs of modern management, effective measures have a positive impact on supply chain management because it helps to understand the entire system, affecting the behavior of members and partners with Partners and stakeholders in the current situation (Fawcett & Clinton, 1996). Which is a useful tool for good decision making and is a key success factor for successful innovation (Soosay & Chapman, 2006).

### **1.5.7. Resource Based View (RBV)**

Resource Based View is a collection of information used in all parts of the department to be organized and used to develop strategic negotiation and management systems. Results of using RBV are collections of resource information such as sources, data, and effects of using resources on the competitive advantage. Creating efficiency of the supply chain must use internal and external resource information to gain insights which influences competitive improvement (J. Barney, 1991).

## **1.6 Scope of the study**

The population is frozen food industry in Thailand, information from the Department of Business Development, member of the Frozen Foods Association of Thailand and registered on the website of the Department of International Trade. Management and staff in all sectors of the frozen food industry in Thailand that used the enterprise resource planning system to manage the operating system and resource information in supply chain management. This research uses the sampling method, simplified sampling landscape and quota sampling from executive and staff of the frozen food industry in Thailand. It uses 400 questionnaires to collect statistical data used for qualitative data analysis. In addition, analysis process by Analysis of Structural Equation Models (SEM). Furthermore, in-depth interviews with executives or top managers from five frozen food industries in Thailand for qualitative data analysis.

## **1.7 Limitation of the Study**

As mentioned above, the purpose of this research, to study the relationship between demand and supply environment, information capabilities and integration of information within the resource planning system, to enhance the supply chain efficiency of the frozen processing industry in Thailand. However, some limitations of this research, interpretation and analysis of data may be influenced by other variables not included in this research and information is only one factor that contributes to forecasting performance of enterprise resource planning and supply chain efficiency. Second, the questionnaire for this research respondents may misinterpret the meaning of the question and the variables that can cause the answer to the question more than the actual. Third, there may be restrictions in internal disclosure and there are examples of organizations. Some organizations are extracted from the same industry as the food processing industry. This may give a different result to other industries.

## **1.8 Organization of the Study**

This study is organized into five chapters.

Chapter One, Introduction, this chapter presents background and statement of the problem for this study, including research objectives, research questions, hypotheses

and conceptual framework, the scope of the study, limitation, and contribution of this study.

Chapter Two, Review of Literature, based on the reviewing of previous studies in related areas to lay a foundation for the study both theoretically and empirically. This chapter is designed to review each of important theoretical concepts used in research works in the field of enterprise resource planning system, demand and supply environment, information capabilities, information integration and supply chain performance. In addition, Resource-Based View perspective will be examined for relevance and application to research questions identified in the study.

Chapter Three, Research methodology, presents methodology relevant to the study, based on research questions, research hypotheses and literature review in Chapter One and Two. Topics of relevant topics are design, research, and survey methodology, sampling plans, measurement properties of selected scales, data analysis, and quantitative measurement schemes. This use to test the validity and reliability of the research structure. Qualitative research is assumed to confirm the quantitative research results.

Chapter Four Analysis of the Data, presents in this chapter is the results findings. The data from empirical survey will be analyzed and presented. This includes the analysis of constructs along with their reliability and validity. The hypothesis testing and summary of findings will report to the extent that hypothesized relationships occurred.

Chapter Five Summary and Conclusions, this chapter presents conclusions from the findings, both from a theoretical and practical perspective, including the discussions of the study, contributions, managerial implications, contributions, limitations, as well as recommendation for future research.

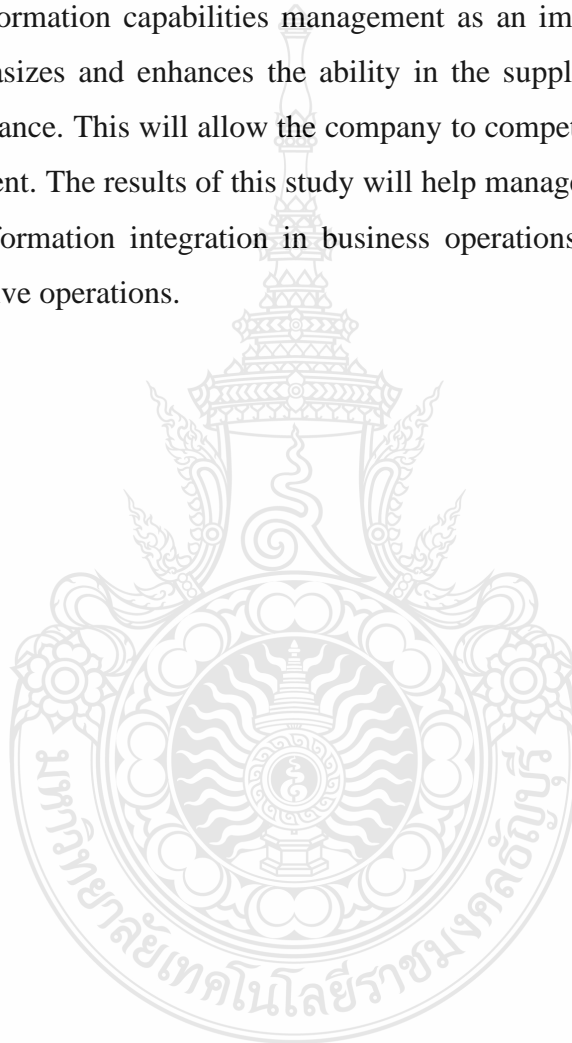
### **1.9 Contribution of the Study**

The results of this study are expected to be relevant both theoretically and practice.

A theory is very important for further study and helps to understand the RBV (Resource-Based View) in supply chain performance by examining the relationship between integrated information and information capabilities. Which RBV used to manage

the information capability of all department. The Companies should use the information of demand and supply environment for planning and procurement in enterprise resources. Furthermore, it applied to the information integration to optimize in the supply chain. Therefore, the companies should be involved in the study of management and operations under RBV.

In this study, the company will be recognized the importance of information integration and information capabilities management as an important part of business success and emphasizes and enhances the ability in the supply chain to optimize the company's performance. This will allow the company to compete in today's competitive business environment. The results of this study will help managers better understand the implications of information integration in business operations and take into account efficient and effective operations.





## **CHAPTER 2**

### **REVIEW OF THE LITERATURE**

In this chapter, the review of the literature consists of five main sections: the first section provides the theoretical perspective of the Resource-Based View of the information in the enterprise resources planning system; the second section discusses information integration of information capabilities on the demand and supply environment; the third section defines the information capabilities which discusses the roles in integrating all other core information capabilities; the fourth section discusses supply chain performance as an evaluation of the information integration process on information capabilities; and finally, the last section proposes the theoretical framework used for the study.

#### **2.1 Enterprise Resources Planning System**

ERP stands for Enterprise Resource Planning, meaning the overall business resource planning to maximize the benefits of organization's business resources. The concept of ERP (Enterprise Resource Planning) began in the 1960s in the USA, based on the MRP (Material Requirement Planning) concept, for all productions, in order to set up material requirement plans and find the enough materials for productions according to the production plans and help reducing inventory and optimize production planning and material procurement. Enterprise Resource Planning (ERP) has been developed and progressed for a long time. The use of ERP includes the need for many changes in the organization such as corporate culture and business process transformation.

ERP system is the information system for resource planning by integrating all core business processes together such as sales orders, purchase orders, inventory management, production planning, production, service orders, and financial and accounting. So, the ERP system is a tool to improve technology for optimizing management in various aspects, including reduce production costs, logistics costs, increase productivity and production. Enterprise Resource Planning (ERP) is considered as an important tool for reducing costs and increasing productions. Enterprise Resource Planning (ERP), which links other systems of the organization together, enhances

efficiency of organization's resources planning and management which results in standardization of the products, reducing production costs and production time, which enhances competitive advantage and efficiency.

Soh et al. (2000) said that Enterprise Resource Planning refers to the overall resource planning of an enterprise in order to utilize organization's resources to achieve maximum benefits. ERP is a tool for managing business to solve the problems within organization, assist in management, investment planning, and efficient management of all corporate resources. ERP will enable seamless link among departments such as procurement, production, and sales. It enhances overall management of the organization to gain maximum benefit, integrates core business processes together, such as financial management, project management, human resource management. ERP is relational system which can create continual connections on the same database. Sharing knowledge among sections departments in an organization is the important factor of using the ERP system.

**2.1.1 Resource Based View Theory (RBV)** which based on the concept called Endogenous Growth is used to see the trend of corporate growth. It is the strategic management for organizing and managing resources each department in the organization in order to gain competitive advantage. Furthermore, if organization considers using Information Technology (IT) as an important part to improve operational processes and developing interactions between IT resources and other resources, it can help solving resource usage problems and improving resource management efficiency which leads business to the better direction. It can also monitor the impact of related resources, enhance competitiveness, and create business opportunities. The abilities of technology and information systems can enhance your organization's capabilities and competitiveness, create core competencies for the organization. The integration of different data from each department will be an important tool, and a good response to customer needs with accuracy and speed, which is considered as a competitive advantage, especially in the same industry.

Resource Based View (RBV) is a collection of information used in all parts of the department to be organized and used to develop strategic negotiation and management systems. Results of using RBV are collections of resource information such as sources,

data, and effects of using resources on the competitive advantage. Creating efficiency of the supply chain must use internal and external resource information to gain insights which influences competitive improvement. Resource Based View Theory (RBV) has been mentioned, related to management and strategic information systems, in many years, mostly about identifying critical information and effects to competitive advantages, or other organizational issues, such as corporate environmental responsibility, competitive advantage, and strategic alliances. However, not only gathering resources may affect these results, but also issues about resource relationships within the organization especially IT resources and interactions of IT resources with other resources that must be used to identify resource management concepts to address resource use issues throughout the supply chain.

In 1991, Barney examined the relationship between Sustainable Competitive Advantage (SCA), where he found four empirical indicators for the source. Data for SCA creation include the value, rareness, imitability, and sustainability. It emphasizes the strategic management more than information system development. In 1992, Mahoney and Pandian pointed out that it was possible to have "Good Conversation" between researchers from different perspectives and disciplines. Examples of IS research using RBV are shown in table 2.1.

**Table 2.1** Examples of IS studies using RBV

<b>Paper title</b>	<b>Author(s), published year</b>	<b>Abstract</b>
Sustaining IT advantage: the role of structural differences.	(Clemons & Row, 1991)	Studying the role of IT in achieving sustained competitive advantage (SCA). It can be concluded that IT itself cannot lead to SCA. However, IT helps other resources to coordinate.
Information technology and sustained competitive advantage: a resource-based analysis advantage	(Mata, Fuerst, & Barney, 1995)	Stating that information resources and IT skills lead to a sustainable competitive advantage. The four IS resources are: access to capital, proprietary technology, technical IT skills, and managerial IT skills.

**Table 2.1** Examples of IS studies using RBV (Cont.)

<b>Paper title</b>	<b>Author(s), published year</b>	<b>Abstract</b>
Develop long-term competitiveness through IT assets	(J. W. Ross, Beath, & Goodhue, 1998)	Determine three IT assets: IT human resources asset, technology asset, and relationship assets. That is a combination of these three assets leading to SCA.
Information technology as competitive advantage: the role of human, business, and technology resources	(Powell & Dent-Micallef, 1997)	IT alone cannot produce SCA. However, IT can use other intangible resources such as human resources and business resources to achieve SCA.
IT capabilities: theoretical perspectives and empirical operationalization	(Bharadwaj, Sambamurthy, & Zmud, 1999)	Six types of IT capabilities, including: IT business partnerships, external IT linkages, business IT strategic, IT business process integration, IT management, and IT infrastructure.
An information company in Mexico: extending the RBV to a developing country context	(Jarvenpaa & Leidner, 1998)	In developing countries, discuss RBV with various IT resources and capabilities in developing countries to gain competitive advantage.
A resource-based perspective on information technology capability and firm technology capability and firm performance: an empirical investigation	(Bharadwaj, 2000)	Comparison of group performance Between those with high IT capabilities, those without IT capabilities. Find that high-level IT professionals can use their corporate data with superior performance.

Although a large number of RBVs have been published over the years, most have identified important resources and examined the impact of resources on competitive advantage (CA) and / or other organizational problems, such as environmental performance of corporate competition and strategic alliances. (Russo & Fouts, 1997). Resource Based View (RBV) was a very well-known theory in the of Information System (IS) field. Previous researches about resources, performance, and competitive advantage were influenced from RBV (Taher, 2012). The RBV of the organization consists of a set of specific resources and organizational management capabilities in order to collect

resources, helps taking advantages of market opportunities which leads to high performance of the organization (Wernerfelt, 1984). As known that resource is the most important analytical unit in the organization (Grant, 1991), we can find the resources and utilized them. RBV is a resource that can lead to CA improvement depending on the nature of the resource (J. Barney, 1991). The current paradigm has arisen to confirm the relationship between a company's resources and its competitive advantage or sustained competitive advantage (Piccoli & Ives, 2005). Suggestions: competitive advantage is the unique ability to create and maintain resources which may be difficult to find, not perfect, unreplaceable, difficult to imitate, and have value to the market of the organization and environment (Taher, 2012). Based on resource-based view theory, J. Barney (1991) claims that the unique resource of company must have the following characteristics: (1) value (2) rareness (3) In-imitability (4) Non-substitutability

### **1) Value**

RBV resources are valuable when it helps organizations to strategically improve efficiency and effectiveness. Value helps companies overcome their competitors or reduce their own weaknesses (J. Barney, 1991), and used as strategy for value creation, such as improving quality or increasing interest, creating a feature to differentiate your competitors or reduce costs (Grant, 1999). The unique and valuable resource of the company can be utilized and emphasizes market entrance (Wernerfelt, 1995). Gellweiler (2018) emphasizes that valuable resources have the potential to be highly rewarded and help the company improve implementations of efficiency and effectiveness strategies.

### **2) Rareness**

Kitrangsikul (2017) mentions that the rare resources of the company must be valuable. Rare resources are hard to find, limited, or acquired by a few companies and cannot be accessed or distributed equally between competitors. Hence, must be considered to gain competitive advantages. Only a few companies with the same resources will result in equality in the competition (Rothaermel, 2013).

### **3) In-imitability**

Kitrangsikul (2017) explained that imitation, which refers to copy or replication, is difficult or impossible. The company's valuable resources must be difficult to copy or replicate by competitors or other companies. It may be because of the complexity of the

resources, or the problem of finding resources (Madhani, 2009), or other factors such as social complexity (Dierickx & Cool, 1989). If company can control its valuable resources, disallow other systems to replicate or copy the resources, go through a unique development cycle, that will lead to the company's competitive advantages (J. Barney, 1991). Ryman (1999) stated that companies must protect valuable resources from imitation by competitors, otherwise they would lose their competitive advantages. Competitive advantage can be sustainable, if competitors cannot completely imitate resources or strategic assets. Resources become difficult to imitate when business integration profoundly through a unique development path, for example, brand loyalty or loyalty to culture of the company. The key factor is ambiguity, which refers to unclear source of competitive advantage (Peteraf, 1993). Company must increase difficulties to strategic resources imitation (Rumelt & Lamb, 1984) to prevent easy imitations of these strategic resources and use them to compete with companies which own the valuable resources (Mahoney & Pandian, 1992).

#### **4) Non-substitutability**

Kitrangsikul (2017) non-substitutability is a feature of resources that causes difficulties in replacing with other resources to gain equivalent outcomes. When the organization has a rare and useless resource, competitors might try to find their ways to utilize by search for related resources. Company will gain higher business position than the one that cannot easily find the related pair.

Non-substitutability resources mean that resources cannot be replaced or cannot be replaced with similar resources. The importance of non-substitutability is that company will have valuable resources that are rare and difficult to imitate. But if replacement qualification is not available, source of competitive advantages will not be considered (Dierickx & Cool, 1989) By definition, resource cannot be substituted if no equivalent resource available for substitution, or enough to replace existing resources (Talaja, 2012). This barrier is a barrier to competitor's ability to copy or replicate strategic resources which results in unequal resource distribution and inability to switch resources among competitors in the business. This leads to longstanding differences in the company (Oliver, 1997).

When organizations hold valuable, rare, inimitable and unreplaceable resources, it's considered as organizational strategy (Teece, Pisano, & Shuen, 1997).

## **2.2 Demand and Supply Environment**

Business Environment Impact all times, the performance of an organization does not only come from the internal processes of the organization. However, it also depends on the external environment as well. Consequently, information related to the supply and demand environment is an important part of the stakeholders throughout the supply chain. This means the beneficiaries and the losers of the benefits of export business from the upstream to the downstream (Consisting of farmers, collectors or buyers, manufacturers, distributors, wholesalers, retailers, and staff related to operations, and consumers) that the organization must adopt the ERP system to enhance the performance and reduce the uncontrolled impacts on the organization. In consequence to this, organizations need to be aware of the problems and opportunities that are the key components of business environment impacting organizational performance. The problems are what keep the organization responding to the solutions to the problems and opportunities to develop the organization to be effective in the business process. All organizations must have clear goals, strategies, and policy planning that information technology called ERP System is used in the organization. The mentioned system will have to support the work in various areas to help business operations at different levels of the organization and will accommodate different benefits; for example, marketing department uses information technology to help determine the customer segment; help develop products and services to meet customer needs; sales and services support; and customer service. The production department uses information technology to assist in planning for product and service, and development and production flow control. For Accounting and Finance department uses information technology to track the storage and use of corporate assets, and the flow of capital.

Therefore, the integration of information capabilities in the supply and demand environment by utilizing the information in the ERP system to integrate throughout the supply chain will help support the Demand and Supply response to the overall supply

chain of the organization as a whole. Conclusions of research related to Demand and Supply Environment:

**Table 2.2** Summary table of findings related to demand and supply environment

Title	Author(s) (Year)	Finding
Effect of bioenergy demands and supply response on markets, carbon, and land use.	Abt, Abt, and Galik (2012)	Increased demand has the effect of capturing and increasing quantities of raw materials and yield. Supply responsiveness is important in refining the increased market response. The difference of each time. This may affect the Demand response.
Increased visibility during order management in a network-based supply chain environment	Mikurak (2012)	The network-based supply chain framework provides a common set of orders between service entities, Agent manufacturers and consumers are automatically provided through the network. It tracks your progress from person to person, process by periodically tracking the list, and transmission to relevant business entities.
An integrated supply chain problem with environmental considerations.	Diabat and Al-Salem (2015)	The continued rise of environmental awareness has affected many aspects of the global economy. Including supply chain management to reduce costs and increase profits. At present, there is insufficient information in the organization, resulting in insufficient inventory to be delivered to consumers. This is the original problem at the factory. Many Distribution Centers (DCs) and retailers are uncertain. The problem of the complexity of the reporting system that is required to solve the problem within a reasonable time.



**Table 2.2** Summary table of findings related to demand and supply environment  
(Cont.)

Title	Author(s) (Year)	Finding
Can evolution supply what ecology demands?	Kokko et al. (2017)	Complexity of Demand and Supply variations encourages new synthesis efforts in order to adapt to the changing environment of the economy and consumption of the market, Supply must be ready to change the demand for tracking and adaptation.
The evolution of the internet of things industry and market in China: An interplay of institutions, demands and supply.	Kshetri (2017)	Supply and demand, and factors related to the environment of production and distribution, as well as products. It Utilizing the vast amount of information and databases to manage supply chain information productivity and efficiently. All parties agree to the terms of use of equipment with a platform that is effective and similar to the exchange of accurate and accurate information safe from threats
Incorporating location and inventory decisions into a supply chain design problem with uncertain demands and lead times.	Diabat et al. (2017)	Supply chain network with distribution centers and retailers. Considering the amount of inventory in the right warehouse and the location that is convenient for shipping the product to the consumer. Which the uncertainty of the requirements and the time to replenish the product. They need to model the queue to solve the problem with large data and use the information provided in the system to solve problems in depth.

**Table 2.3** Summary definition of demand and supply

Reference	Summary Definition
Mohr and Spekman (1994)	Sharing of information Delivering a partnership with suppliers
Shin, Collier, and Wilson (2000)	A partnership strategy with suppliers is the element of supply chain management strategy.
Li and Lin (2006)	Partnership strategic with suppliers, information sharing, information quality, customers relationship, and the delay of delivery affect the operation.

Efficiency refers to the process, method, or any action leading to success by using resources such as natural resources, labor, capital, and operation or entrepreneur approaches, which have the highest quality in operation to the fullest potential. However, any operation depends on the resources at that time that how much the quality and quantity there are. If there is very high quality, they will be used the fullest potential, by using them in small amount, then it can be called effective. In contrast to high-volume, low-quality resources, the choice of how to maximize resources can be called effective.

### 2.3 Information Integration

Information integration can be achieved by using IT techniques for coordination between vendors, facilitating interaction between vendors and customers. (Demand-side and supply side) and reduce transaction costs (Yang & Maxwell, 2011). The main obstacles that organizations face in their data integration include privacy, information, motivation, reliability, cost and complexity of technology, accuracy, and the efficient data usage (Zhao, Xie, & Zhang, 2002).

Information Integration Theory is a part of information management theory, which studies about how people function to collect data and manage various types of information. Therefore, information integration requires the data warehouse technology to store information which has passed through classification. Data warehouse is used for information and knowledge management which the goal is to develop interchangeability, and information sharing and integration based on the development of information systems by software.

Fortier, Potter, Grady, Lohr, and Klein (1998) provides the definition of information integration that it is extracting the knowledge and the capability of information and technology which is an individual ability or that of the organization. In order to use information and technology for their own work or to work with others, the ability to use tools, data sources, processes and retrieval systems, information valuation\_ including the ability to use this information to solve a problem, communication, decision, including the creation of new knowledge, products or systems.

Curran and Curran (1991), discusses the attributes of knowledgeable and understanding people, who can use the knowledge that the organization must be able to apply the capabilities of the information as follows:

- 1) Know how information is useful
- 2) Know where to find information
- 3) Able to retrieve the information
- 4) Able to describe, organize and synthesize information
- 5) Able to use and present information

The integration of information capabilities and the characteristics of information in accordance with the meaning of the term "information literacy" refers to the skill and ability to seek and access the information using computer equipment, and modern technology. The characteristics of the information must be able to answer the questions and identify the information they need by themselves. Moreover, they have to be able to consider, analyze and link things in a rational way. Besides, they must be able to select and evaluate the information that meets the needs, including the ability to synthesize, plan how to study and research and describe or appropriately present the information obtained from the study. Information integration may be used together with other theories, such as the theory of interpersonal relationships i.e. the classical theory of the Palo Alto group, which deals with the relationships that arise from communication that are both in the same way and the opposite way, and the theory that concerns with relationships in communication which discusses the dimension of interpersonal relationships that there are 3 dimensions: dimension of control, dimension of trust and dimension showing intimacy in order to obtain information that is linked into a system with values, rareness,

imitability, and sustainable to develop sustained competitive advantage. (J. Barney, 1991)

Information integration is a challenge for organizations which should be accelerated to manage data and information systems contained in Data Warehouse. It providing useful information to be analyzed and synthesized to present various ways to manage database and search for new technologies and applications to help speed up the information integration, make it accurate, and meet the needs of different users to estimate and forecast the demand and supply of consumers. Another challenge for information integration, the organizations may integrate the capabilities of research Information Management (RIM), which has many features for combining data from various scenarios, which are the source of a variety of information styles and the meanings of the words. In addition, many stakeholders have contributed to the development of RIM systems for data integration applications for data management, research, problem analysis, integration, as a preliminary approach to data integration by data modeling and mapping the models and similar information integration processes to share information with each other through the tools and the technologies of the service provider who has the best data management control system. Then consumers can share information on relatively little risk by using these tools, such as Microsoft Office 365, Gmail, Drop Box, and Facebook, etc. Organizations can use the outstanding features of each platform with a service called Software as a Service (SaaS). The example of SaaS is a model of a program with a set of commands to use and efficient delivery of information through the server, and create the challenge for data migration which is useful as follows: On-demand self-service: service providers are independent in order for the system to compute by itself automatically at a given time. It may include scheduling the server to store or select the platform as required. It provides details such as specific consumer demand patterns for definitions and measure of success. For example, from a consumer perspective, it is important to have a different understanding. It also includes a physical security system to monitor personal safety, identity data management, privacy applications security in legal issues, business continuity, data recovery, login into the system, checking route through data control, the display of the complete system according to the infrastructure and operational requirements of the various departments in an organization or a partner company, the

shared responsibility between the service provider and the consumers, which depends on the types of deployment and the delivery model. Consumers need to understand the legal implications of how the infrastructure services and data integrity are maintained.

### **2.3.1 Resource Integration**

In a multi-user environment, cloud services will create a pool of resources to serve together. The users can define the requirements and the resource integration based on Multi Tenancy in multiple shared enterprise environmental resources by technical setting of cloud adoption, which is a separate requirement the context is important for maintaining the integrity of the resource to reduce the potential complication, because the general cloud service area, there are many service providers and diverse users.

### **2.3.2 Flexibility of Fast Service**

Economic uncertainty requires release and fast expansion of service provision so that the stakeholders in the system can procure the right amount of raw materials of goods and services automatically to benefit and create a sustainable competitive advantage, etc.

In general, business organizations often have separate operations; each section will work independently. In this way, the organization may not be able to effectively meet the needs of customers. The concept of integration in the supply chain then focuses on the interplay of activities and processes without the need for any seams. There are two types of integration as follows:

#### **1) Internal Supply Chain Integration**

It is the interplay of activities and processes within a single organization. The integration of the supply chain within the organization is geared towards breaking down the walls between the various parts within the organization to achieve a link and more support from one another, especially, these areas are: procurement, planning and control of warehouse management, transportation management, and customer relationship management (Hogan, Soutar, McColl-Kennedy, & Sweeney, 2011) etc. Many large organizations focus on supply chain management by the appointment of the director of supply chain management, whose main responsibilities are in supply chain management i.e., operations, procurement, and logistics.

## 2) External Supply Chain Integration.

It can be said that supply chain is a network of organizations linked to the implementation integration. The goal of each organization is to manage the supply chain upstream and downstream to increase their own competitiveness to have better products or service than the competitors (Verma & Boyer, 2010). External supply chain integration is networking with other organizations, both in the purchaser's side and customer's base, products or services shipped to customers, who are the last consumers. Working through the various organizations in the supply chain, if any organization in the supply chain is inefficient in operation, it will cause the whole supply chain to be uncompetitive as well. If considering in term of the competition, it will find that there is a shift from the competition between business organizations to supply chain competition (Hogan et al., 2011). The factors affecting the efficiency of the supply chain are caused by the ability to respond well to the needs of customers. The organizations in the supply chain must take into account the driver factors which consist of inventory management, transportation management, facility management, and information management (Chopra & Meindl, 2001).

The impacts of each driver factor are as follows.

### 1) Inventory Management

Inventory consists of raw materials, work in the production process, finished goods, raw material suppliers, manufacturers, wholesalers, and retailers, the inventory in the supply chain are inconsistent between demand and supply, and the important role of raw material circulation process in the supply chain. Inventory can meet the customers' needs when they have demand as well as help reduce the cost of production and distribution costs (Mazzawi & Alawamleh, 2013). Inventory is both the source of the main cost in the supply chain. Changes of inventory policy have a great effect on performance and responsiveness to customer needs of supply chains. Having a large amount of inventory will help the company respond to the needs of customers well. However, this will increase the cost of the business, and reduce the efficiency of management. If inventory is reduced, management efficiency will increase, but the ability in response to customer demand is reduced (Chopra & Meindl, 2007).

## 2) Transportation Management

Transportation management is the management of inventory from one point to another, including the development of functions in the cargo moving system to reduce costs. Transportation has a huge impact on the ability to respond to the needs of customer, and efficiency of the supply chain. Each transportation model will have different characteristics (Mazzawi & Alawamleh, 2013). Carrying out own transportation or hire a transport contractor is important for the corporate executives to take decisions, whether the focus will be on providing supply chains with the ability to respond to customer needs or focus on the efficacy of the performance. Transportation management that can meet the needs of customers very well, but it costs a lot or if reduction of transportation cost is needed to maximize efficiency; nonetheless, the ability to respond to customer needs will be reduced accordingly (Chopra & Meindl, 2007). A good method to manage transportation is joint route planning, which can be divided into two categories: outsourcing and the use of transport services, from the size and level of the agency, which provide horizontal transport cooperation (Crujissen, Bräysy, Dullaert, Fleuren, & Salomon, 2007).

## 3) Facilities Management

Facilities management is one of the key factors. In driving the supply chain which is related to the decision on the role of the location, the capacity, the suppliers of raw materials, the customer. In addition, it includes the costs of employment, infrastructure, and transportation (Mazzawi & Alawamleh, 2013). The locations in the supply chain network can be classified into two categories: production locations and inventory storage locations. Both types of locations have a huge impact on the response to the demand of the customers and supply chain performance. Having only a single production or storage facility will provide the organization with economies of scale and efficiency. Nevertheless, the ability to respond to customer needs is reduced. On the other hand, having multiple production sites or locations to keep goods close to customers will make the organization more responsive to customer needs, but it costs more and will affect the performance in the administration. So, what to consider about the facility is to consider the suitability between the costs in terms of the number of places in production

or places to store, and the level of the ability to respond to customer needs (Chopra & Meindl, 2007).

#### 4) Information Management

Information management consists of information managing about inventory, transportation, facilities, and customers across the supply chain. Information is the most influential factor in supply chain performance, because the information is relevant, and it affects the factors to drive all the supply chain (Mazzawi & Alawamleh, 2013). The use of more information sharing will make the organizations in the supply chain have a better performance (Yu, Yan, & Edwin Cheng, 2001), and help decrease the level of inventory, resulting in saving the costs, as well as quickly meeting the needs of the customers, and having more efficiency.

Information data sharing between the members in the supply chain then leads to the competitive advantage of the members, from the dimension of value added to the customers, and cost reduction (Mazzawi & Alawamleh, 2013). Information is the connection between the various stages of the supply chain to be able to harmonize and maximize the profits to the whole supply chain. Executives must find ways to facilitate coordination and sharing of information in the supply chain.

Internet technology is accessible to anyone, anywhere, and can transmit a lot of information, thus everyone can see the data pictures and the needs for demand and supply and demand better and clearer. This allows organizations to study and understand the activities throughout the supply chain for better decision making.

In addition, if the communication between organizations in any periods of the supply chain is using the Internet to help. That will make the systems easy coordination because it uses the same standard in the World Wide Web format. Although, many information systems will improve the efficiency to meet customer needs, the executives also have to consider the advantages and disadvantages of the ability to meet customer needs as a result of the reduced efficiency of information in the supply chain, because of the high cost of information (Chopra & Meindl, 2007). From the involved research, Mazzawi and Alawamleh (2013) studied the impact of supply chain performance driving factors and value chains towards business organizations for food industry in Jordan. The



purpose was to study supply chain performance driving factors and value chains with the impact on business organizations. The finding is that the organization will be successful, there must be a good supply chain operation, in addition to, coordinating and sharing information among different parts of the value chains.

Shahzadi, Amin, and Chaudhary (2013) studied the supply chain performance driving factors affecting the productivity increasing of enterprises in the industrial sector. The purpose is to study the driving factors of efficiency of supply chain and create a conceptual framework for managing corporate drivers factors. It is found that the following factors: facility management, inventory management, transportation management, information dissemination managing, supply chain activities management, and pricing are the factors having a relationship and have a significant impact on the performance of the organization. Therefore, the organizations must manage these factors to balance the performance and response to customer needs.

Yu et al. (2001), studies about the benefits of sharing information with cooperation in the supply chain by studying the benefits of cooperation between the supply chain and sharing information. The researcher found that decentralized supply chain system consists of manufacturers and retailers. Both manufacturers and retailers will see better performance due to lower inventories and cost savings because more information is shared.

Sharma, Giri, and Rai (2013) did the research on Supply Chain Management in India. The purpose was to study the development guidelines to increase the efficiency of the supply chain in India. The results of the study were as follows:

1) Collaboration: Information technology plays a very important role in the structure of all levels of cooperation in the supply chain. Information exchange between partners, both wholesalers and retailers make the response to the needs of the customers as consumer effectively. If the information is not properly managed, it may cause a Bullwhip Effect, which refers to the variability in planning and inventory forecasts at different levels in the supply chain; as a result, there is too large amount of inventory or too small. It will result in poor management. In addition, the companies which are partners, both wholesalers, and retailers must exchange information with all members of the supply chain to collaborate on inventory forecasting and planning, too.

2) Inventory Management: A partner company needs to gather the right amount of demand and close to the needs of the buyers and sellers to estimate the right needs for demand and supply to reduce the volume of their inventory.

3) Procurement: A partner company must cooperate with retailers to forecast the highest and lowest demand for frozen food at various times throughout the year and to seek raw materials during the off-season so that it can control the production process to ensure the quality of the frozen food in accordance with the market's needs.

4) Logistics: The counterparts should reduce the number of intermediaries to the minimum. There should be a place and a center for the purchase of raw materials directly of the company without intermediaries. The company may have a distribution center to collect all the orders from retailers in the area, and send to several retailers with several trucks (Milk Run Routing System) etc.

In conclusion, business administration needs to be able to keep up with more rapid changes and complexities. Any entrepreneur who can adapt quickly and can meet the needs of the customer will be advantageous for competition. Thus, the current and future business practices need a tool called Supply Chain Management to use for the development of four operational processes as follows: Planning, Sourcing, Production, and Delivery. To be consistent throughout the operation, supply chain management is central to the development of the country. In particular, the industrial sector should give priority in encouraging all relevant industry personnel to gain insight into the concept of supply chain management that will be used in strategic planning to develop and improve business processes, and the relationship between partners. Understand the standards to lead to consistent business management and to meet the needs of final customers effectively. Managers are responsible for inspiring group members of the supply chain to achieve collaborative learning, which is consistent with the concept of leadership that leaders influence the work of corporate members (Griffin & Moorhead, 2011). The idea is that Transformational Leadership allows members of the organization to share goals and tailor the strategy accordingly. Including support the team to work as a teamwork leading to self-confidence (Zhang, Cao, & Tjosvold, 2011). The ability to integrate knowledge demonstrating the collaboration of members with a starting point or concept of collaboration from the beginning, resulting in the sharing of raw materials used in the

production of each group from different sources, making learning and getting information for the continued operation of the group. Information sharing demonstrates the close business of the communities and its customers, which makes it more convenient to exchange information with each other. In line with Muchiri and McMurray (2015)'s concept that leadership behaviors lead to an entrepreneurial focus of the teams in the organization. The ability to integrate is the knowledge with an important role in communicating the market or supplying raw materials or exchanging knowledge within the other groups, including activities operations such as raw material procurement, the exchange of knowledge within marketing groups. The ability to integrate knowledge is consistent with a grounded view of resources (RBV) that focuses on resources or knowledge to the competitive advantage of the organization.

According to Y. J. Kim, Song, Sambamurthy, and Lee (2012) who found that the ability to integrate knowledge leads to an increase in organizational performance, and in accordance with Peng Wong and Yew Wong (2011), who found that knowledge management capabilities on supply chain management practices, and the effects of supply chain management practices had a significant impact on firm performance.

**Table 2.4** Summary table of research definitions

<b>Title</b>	<b>Author (Year)</b>	<b>Definition of Information Integration</b>
Integration theory applied to judging the value of information	Shanteau and Anderson (1972)	Valuation of decision data can be determined by three variables: data volume prior to demand control. Accuracy of data and return on correct decision.
Information integration in customer risk perception: A comparison of two models of component conceptualization.	Bettman (1975)	Information integration for stakeholder risk perception using the same database. It is focus on the use of raw materials and products.
Decision making and information integration in the courts: The Setting of Bail	Ebbesen and Konecni (1975)	Check the impact of different types of information to make decisions.

**Table 2.4** Summary table of research definitions (Cont.)

<b>Title</b>	<b>Author (Year)</b>	<b>Definition of Information Integration</b>
An information integration analysis of group decision-making attitude change	Anderson and Graesser (1976)	The benefits of Information Integration Theory can be used to solve many dynamic problems. Like reducing the risk of being unaware or not use the available information to create competitive advantage.
Information integration using logical views	Ullman (1997)	The concept of using SaaS tools (Software as a Service) in data integration. To create a query in a variety of views.
Virtual Integration Theory of Improved Supply-Chain Performance	Wang, Tai, and Wei (2006)	Capabilities management and supply chain flexibility enable manufacturers in today's competitive and uncertain environment to integrate virtualized systems into their ownership. Collaboration and integration through information technology (IT) to work with supply chain. The development of integrative theory makes it possible to view empirical data. Role tracking and data integration to facilitate the manufacturer. Increased flexibility in production and comparative advantage. Under uncertainty, the environment tends to encourage manufacturers to increase production flexibility by responding to virtual and responsive suppliers that play a significant role in production. Environmental uncertainty is a threat to the manufacturer. But with the help of IT and the more responsive suppliers. Threats can change into competitive advantage.

**Table 2.4** Summary table of research definitions (Cont.)

<b>Title</b>	<b>Author (Year)</b>	<b>Definition of Information Integration</b>
The impact of supplier chain integration on performance: A contingency and configuration approach.	Flynn, Huo, and Zhao (2010)	Supply chain integration (SCI) of supplier group have strategic with supply chain partners. They manage internal and inter-enterprise processes to achieve efficient and effective flow of information, products and services that focus on integrating customer and supplier to decision and, helping customers have more value. Including internal links. Determining the impact of each SCI dimension (suppliers and, internal integration), and interaction with performance. Which, Integration within the organization with customers is more relevant to improving efficiency more than distributor consolidation
The impact of supplier integration on customer integration and new product performance: The mediating role of manufacturing flexibility under trust theory	He, Lai, Sun, and Chen (2014)	The impact of supply chain integration on new product development has been studied and examined, the relationship between supplier integration and customer integration. When they affect the performance of new products. They explore complex relationships between vendor integration, customer integration, and new product performance to find flexibility in production and service under credible theories. Include distributors and customer groups to reduce the direct impact on performance. This leads to the integration of supply chains and reduce the complexity of integration between distributors and customers.
Value of Information Integration to Supply Chain Management: Roles of Internal and External Contingencies	Wong, Lai, and Cheng (2011)	Adoption of partnerships that affect the success of data integration from uncertainty theory. Improved performance in the supply chain process. Information integration will increase the company's operational capabilities. Especially, when working under a favorable environment. The environment is fair, and uncertain. This may affect the integration of supply chain management customer-focused cost and performance data under favorable and unfavorable circumstances.

**Table 2.5** Summary of prior literature on the relationship between SCI and performance

<b>Study</b>	<b>Dimensions of supply chain integration</b>	<b>Performance</b>
Devaraj, Krajewski, and Wei (2007)	Supplier integration Customer integration	Operational performance
Frohlich and Westbrook (2001)	Supplier integration Customer integration	Productivity performance Non-productivity performance
Germain and Iyer (2006)	Internal integration Downstream integration	Logistics performance Financial performance
Germain and Iyer (2006)	Logistics-production integration Logistics-marketing integration External integration	Cost reduction Stock-out reduction Lead time reduction
Narasimhan and Kim (2002)	Internal integration Supplier integration Customer integration	Moderator of the relationship between international market/product diversification and firm performance
Pagell (2004)	Internal integration	Performance
Rosenzweig, Roth, and Dean Jr (2003)	Supply Chain Integration	Competitive capabilities Business performance
Stank, Keller, and Daugherty (2001)	Internal collaboration External collaboration	Logistics service performance
Swink, Narasimhan, and Wang (2007)	Strategic supplier integration Strategic customer integration	Manufacturing competitive capabilities Business performance

### 2.3.3 Resource-Based View of the Information

Therefore, changes in both internal and external environments in the globalization make the organization cannot stop because if there is no development of firm performance, the organization will not be able to compete with the competitors and will eventually not be able to survive (J. Barney, 1991; Grant, 1991). This makes the entrepreneurs always develop themselves to keep up with the current competitive environment.

In addition to fighting with the same competitors, they also have to fight with new competitors trying to grab the market share. Entrepreneurs need to make their

business the most competitive advantage (Porter, 1991). From the aforementioned competition, organizations then focus on what they already have i.e. the resources of the organization, both tangible resources, such as human resources, raw materials, machinery, etc., and intangible resources such as knowledge, skills, the expertise and the reputation of the organization, etc. (Rumelt & Lamb, 1984; Wernerfelt, 1984). Organizational resource is the key factor in the creation of firm competency, which the organization has accumulated resources of knowledge and skills, in such way that the organization must be able to access and develop in every aspect. (J. Barney, 1991; Grant, 1991). It is the ability to integrate human resources and working process together, which the organization can use its existing resources to meet the needs of all parties quickly and timely with quality (Wernerfelt, 1984). Then it is the ability called, “cannot remain the same, but need to have dynamic capability in accordance with the changing environment.” (dynamic capability) (J. Barney, 1991; Grant, 1991; Porter, 1991) The focus on the existing resources of the organization is in accordance with the concept of Resource Base View Theory, which is a contemporary theory that integrates in-depth data concerning the acquisition of competitive advantage and the existence of the organization within the scope of good management (J. Barney, 1991; Grant, 1991; Wernerfelt, 1984).

Resource Based theory is the theory that critics see that it is useful to acquire certain operations of the organization, and there is the connection between organizational resources and competency and sustainably competitive advantage (J. Barney, 1991; Grant, 1991; Porter, 1991). The concept of Resource Based View Theory (RBV) emphasizes the differences of resources that it is an important factor that helps the organization have a competitive advantage, which will make the organization perform better than other competitors in the industry (J. Barney, 1991; Porter, 1991). Nevertheless, the organizations must have a management approach that can integrate those values and apply to the organizations and be able to develop those unique abilities, and then acquire the distinguished and superior to the competitors. The organization's resources are all the assets of the organization, i.e. the capabilities of the organization, working process, identity of the organization, information, experience, knowledge and technology (J. Barney, 1991; Grant, 1991; Peteraf, 1993; Wernerfelt, 1984). In addition, the organization's resources are also the ability to define or plan work and combine different

resources together with working process used in the organization to achieve what the organization needs (Amit & Schoemaker, 1993; J. Barney, 1991; Grant, 1991; Porter, 1991; Rumelt & Lamb, 1984). The concept of resource base view of any firm which owns valuable resources of a business is rare, inimitable, and non-substitutable (cannot use anything to replace it) (J. Barney, 1991). It is the critical readiness of resources and the factors present in the organization.

Resource based view theory is the theory that states the organization focusing on the resources within an organization will provide the organization with a competitive advantage. Therefore, organizations should consider the existing resources and capabilities to create differentiation and competitiveness, human capital which are environmentally friendly by the development of human capital to have the competence to maintain and control the production process. Cherian and Jacob (2012) efficiently and effectively, including the planning of human resources development in order to adjust the process in accordance with the environment in a green environment (Renwick, Redman, & Maguire, 2013) to respond to the changes that occur all the times from the external environment (Jackson, Renwick, Jabbour, & Muller-Camen, 2011). Barney's (1991) study suggests the concept about the resources that it refers to assets, capabilities, organization process, firm attributes, information, and knowledge which organizations can exploit these resources by the control of human resources management.

In addition, Barney's (1991) study also provides an idea of the organization that will be able to create organizational specificities to achieve the potential for competitive advantage. That the business will always survive and succeed in a complex and dynamic environment it depends on the ability to change oneself at any time, and there are three important factors: (1) the ability to possess unique or special resources; (2) the ability to use resources efficiently and (3) the ability to upgrade the work acquired based on non-stop learning. All three factors are important features or the foundation of business expansion at all levels. Both national and international. They are necessary abilities to make a sustainably successful organization in a globalized economy. That the organizations see the issue of having superior resources has been used in strategic planning groups (J. Barney, 1991; Grant, 1991) to enable the entrepreneurs to gain sustainably competitive advantage (Grant, 1991; Porter, 1991), which the human



resources of entrepreneurs are regarded as intellectual capital and are the most important factor to build up organization's core competencies (Prahalad & Hamel, 1990) to enable organizations to offer valuable products and services based on customers' perception and the needs for operators to continually develop the core competencies in the long run (Prahalad & Hamel, 1990). From the concept above, it is concluded that the most important component for entrepreneurs who want to succeed and create something superior to other organizations is the knowledgeable workers (Prahalad & Hamel, 1990; Stank et al., 2001) and has the ability in information integration from the information capabilities that occur throughout the supply chain. For this reason, entrepreneurs place importance on the ability of personnel to integrate information more from the capabilities of the information within the organization.

Supply chain theory is divided into 2 perspectives:

1) Process Perspective of Supply Chain.

Supply Chain Management focuses on meeting customers' needs and integrating business processes, from customer demand planning to distribution, which leads to success in business operations. The steps of supply chain management are to get the customer's needs for delivering the right product, both the quantity and quality from good raw materials sources, and reasonable prices (Pandiyan Kaliani Sundram, Razak Ibrahim, & Chandran Govindaraju, 2011). Supply chain management is the integration of various departments, from raw material supplier, shipping companies, manufacturers, warehouses, and stores together effectively in order to ensure proper production and distribution of right quantity, right place, and right time. The goal is to reduce the cost of the whole system as low as possible and still continue to respond to customers' needs at the desired level (Simchi-Levi, Kaminsky, Simchi-Levi, & Shankar, 2008). Supply Chain Management integrates between raw material suppliers, manufacturers, distributors, and customers to achieve efficient and effective development and improvement of each organization (Lenny Koh, Demirbag, Bayraktar, Tatoglu, & Zaim, 2007). The integration begins with the planning and control of raw materials, logistics, services, and getting information from the shippers to the manufacturer of the product and service to the customers. It is therefore the most important in changing business practices and management (Fantazy, Kumar, & Kumar, 2010).

## 2) Supply Chain Management Practice Concepts

Supply Chain Management practice is a view of the organization's ability to focus on the Strategic Supplier Partnership (SSP), Consumer Relationship, Information Sharing (Pandiyani Kaliani Sundram et al., 2011), and the movement of raw materials and information exchange focusing on moving information (Zhou & Benton Jr, 2007). Supply Chain Management is the core competency of the organization for the development and improvement of the organization, beginning from the upstream involving allied strategies of the raw materials or goods distributors and downstream strategy (Downstream) that involves the customer relationship including quality data sources within the supply chain process. Enhancing the ability of operators in today's competitive world, most organizations utilize supply chain management since they need a competitive advantage (Morris & Calantone, 1991) to improve performance (Zhao, Flynn, & Roth, 2007). To create a competitive advantage, the supply chain requires the cooperation of those involved in the relationship chain, starting from the relationship among agencies under the supply chain.

The theories used in the study to enhance competitiveness and are widely used are: Industrial Organization (IO): IO Theory, the basis of this theory emphasizes on the external environment more than internal (Zou, Fang, & Zhao, 2003). While McGahan and Porter (1997) found that internal factors in an organization influenced organizational performance rather than external factors. However, there were many researchers such as J. Barney (1991), and Day (1994) examine the relationship between resources and organizational capabilities and performance by using Resource Based View Theory (J. B. Barney & Clark, 2007) related to internal factors that affect the organization focusing on enterprise resources are at the heart of an organization's competitive advantage. In order to be competitive, one should take the view of many theories together (Eisenhardt, 1989). The researchers have adopted the concepts of Supply Chain Management, Resource Based View Theory, and Information Integration Theory to study to link social sciences together.

**Table 2.6** Summary definition of resource based view theory.

<b>Researcher (s)</b>	<b>Summary</b>
McEvily and Chakravarthy (2002)	Supply management strategy is Resource Based View Theory.
J. Barney (1991); Grant (1991)	The capabilities of the organization the element of Resource Based View Theory.
Penrose (1959)	In general, RBV consists of a set of specific resources and organizational management capabilities to integrate resources, enabling organizations to take advantage of market opportunities that are conducive to the organization's work.
PAN, PAN, and TAHER (2008)	Resource Theory (RBV) is discussed in strategic management and information systems (IS). They identify important resources and examine the impact of resources on competitive advantage and / or other organizational problems such as Corporate environmental performance, competitiveness and strategic alliances.
Andreu and Ciborra (1996); Bharadwaj (2000); Melville, Kraemer, and Gurbaxani (2004)	RBV is widely used in Information System. The previous IS research related to resources, performance, and Competitive Advertence (CA) is influenced by Resource Based View
Grant (1991)	That resource is the most basic analysis unit in the organization's process
J. Barney (1991)	RBV argues that gathering resources that may lead to increased demand
Amit and Schoemaker (1993); Teece et al. (1997)	The resources are valuable, rare, inimitable, and non-substitutable are considered strategies

## **2.4 Information Capabilities**

The up-to-date Information Quality Guidelines provided by the United States Patent and Trademark Office (C Marinagi, Trivellas, & Reklitis, 2015) define Quality as an “encompassing term comprising objectivity, utility, and integrity”. Objectivity involves two elements: presentation, and substance. The presentation element focuses on ensuring accurate, clear, complete, and unbiased presentation of information, while the substance element focuses on ensuring accurate, reliable, and unbiased information. Utility refers to the usefulness of information. While integrity refers to the security of information.

Information capabilities is an information quality that includes beliefs, ability to interpret reputation, reputation, value added, integrity, objectivity, reliability, safety, timeliness, price, validation, availability, time respond (Naumann & Rolker, 2005). Presenting framework for studying the implementation of effective supply chain management and the relevance of information systems in organizations. Integrating the capabilities of information that occurs under the process of the enterprise resource planning (ERP) system can increase the ability of requirements management in both demand side of buyer or consumer and supply side of seller, distributor, and manufacturer to find raw materials from the sources and bring them into production process in time. Readiness of production in order to deliver product to buyer or consumer relies on Enterprise Information Management System which is the responsibility of corporate executives to integrate the capabilities of information obtained from the ERP process to maximize usability. Be able to forecast market demand for enterprise resources planning both internal (exist inside the organization) and external (need to find more) in accordance with the environment of demand and supply which will lead to the integrations of all processes and activities in all relevant departments throughout the supply chain in order to optimize efficiency and effectiveness throughout the workflow of supply chain.

Thai frozen foods are sold domestic and exported oversea with supply chain management follows the pattern of inventory management according to product types. Supply chain system for foods is for short-time inventory management because foods are easily spoiled, so the cost of food storage is high. Besides, long storage for foods reduces their qualities. Effective supply chain development for exporting Thai frozen fresh foods

must integrate information systems and capabilities of information existed in every department together. Integrating data, information, and every activity in every related department to collect, organize, categorized, analyze, and synthesize to get specific information for quick decision making with accuracy and be able to store on on-line database in order for members of the network to easily reach and retrieve the data. Make internal information systems flexible which efficient information must ready and easy to be used and accessed, in order to create value-added and competitive advantages for business, cause successfulness of the integration, better operations, increasing efficiency and effectiveness throughout Supply Chain.

The ability of information is at the heart of a business in the future. In the frozen fresh food industries, hardware and software technologies are being used as a tool to manage operational processes, control the use of limited resources for maximum benefit and efficiency. Many companies in the food and exporting industries widely use ERP systems, but still rarely share information resources that can be used together since many information from many departments have various relationships, lack of information integration within organization and within members of the network. If the network has been working together on business planning, setting vision about information technology, it will provide internal capabilities of the information to the public, provide network members mutual benefit, save time and money for preparing information to meet each parties' requirements, by holding on to the strategy partnership (Feeny & Willcocks, 1998). Enduring challenges in the exploitation of IT uses information technology in the organization to create valuable information and maximum benefit to the organization.

Information Capabilities, to be effective in business and create maximum benefit to the organization, must come from integration of information resources within the organization and giving value to the following visions. 1) Business and IT Vision. It is the management's responsibility to focus on business and technology to define a shared IT policy for both organizations and partners. Business values Information systems that influence business policy. The IT vision is to bring IT performance to a whole new level of performance and user can choose to use each type of IT to link to the proper information. CIOs must be able to explain "What can technology do and how to use it?" 2) Provide Delivery of IT Service to those involved in the business system. In order to

share and utilize the capabilities of information exist together because this process has low cost with high quality and requires end-users acceptations. 3) Design of IT Architecture. Businesses must provide equipment that have the same or almost the same, through collaborative planning or using Groupware together with Internet, to set up platform standards for businesses and efficient data exchanges on the same network.

Linking information from all sectors together needs 1) Role and experience of CIOs 'commitment and leadership to bring value-added to the business. 2) CIOs' abilities to set up target groups and deliver profits to the organization. 3) Use IS / IT Outsourcings in the relevant area to allow the whole system be able to work together. In order to share the right information quickly and in-time to enhance effectiveness of the decision-making of corporate executives at every level throughout the Supply Chain. So, CIOs need IT / IS Strategy to determine the capability of IT / IS and how to develop capabilities of information to meet the requirements and create value to the business. IT systems are organization's assistive systems such as utilities, warehouses, distribution centers, machinery and equipment, material handling. So, the information management systems are needed to assist the management of each related departments throughout the Supply Chain to gain effectiveness, reduce complexities of data, reduce errors that affect the speed of response to customer needs. The abilities of processed information can be utilized in various aspects such as using abilities of information to forecast demand, analyzing and synthesizing data for pre-assessment of raw materials, forecasting the demand for raw materials for production, forecasting economic conditions and export trends, etc. When talking about the Supply Chain, it will consist of activities ranging from purchasing, warehouse allocation, logistic, quality control, sales, and data management; for example, farmers are producers, processed and transformed by middle men and central market, delivered to exporters and merchants. Therefore, organizations must find ways to work together with all production and service units by creating synergies within the same industries, also called CMN (collaborative manufactory network), to define a common policy, reduce production costs, sustainably meet the needs of customers, increase efficiency and effectiveness in distribution. The heart of supply chain management is the process of managing relationship between customer and supplier, and organization needs

to have cross-functional coordination, especially among group members, which will improve the efficiency of management throughout the Supply Chain.

Information Capabilities is the word which has been widely spoken in the RBV. While developing the concept of resource, the concept of ability, there was someone stated in the document. Since 1990, numerous researchers have been working (Amit & Schoemaker, 1993; Grant, 1991; Teece et al., 1997). Winter (2003), did the research that capability means "the ability to convert inputs into a more valuable output (Amit & Schoemaker, 1993; Wade & Hulland, 2004)."

In addition to this, the rules of Makadok (2001) and Hoopes, Madsen, and Walker (2003) say that empowerment is something that does not exist. "Cannot be focused and just change some parts of it." The ability can be divided into two groups: (1) the ability to be true value or increasing the value of resources. Most researchers focus on "The ability of organizations to conduct activities. (Whether static, dynamic or creative) more efficient than competitors with similar resources " (Bharadwaj, 2000; Grant, 1991; Makadok, 2001; Melville et al., 2004; Teece et al., 1997; Wade & Hulland, 2004; Winter, 2003)". Each organization has its own unique resource element. (2) capabilities and competency that are specific qualities to the organization as well as resources. Valuable ability is rare and irreplaceable which can be regarded as a strategy (Amit & Schoemaker, 1993; Teece et al., 1997). Most researchers believe that capability is more valuable and effective than resources (Amit & Schoemaker, 1993; Andreu & Ciborra, 1996; Bharadwaj, 2000; Eisenhardt, 1989; Grant, 1991; Teece et al., 1997; Wade & Hulland, 2004). In addition, Grant (1991) argues that the integration of knowledge is a form of interaction between knowledge resources, which is the essence of corporate competence, but transferring knowledge to a resource (Amit & Schoemaker, 1993; Eisenhardt, 1989). Furthermore, Teece et al. (1997) argues that capability "cannot be purchased, but must be created" and embedded in the processes of the organization (Winter, 2003). In addition, (Eisenhardt, 1989) also proposed that "True competence consists of identified and specific actions." Based on a literature review of RBV (Resource Based View), most researchers consider the capacity of the resource sources allocation process, and their interaction in ways that will lead to the progress of the organization's performance. In addition to the concept of empowerment, capacity

development has also been mentioned that it's a gradual process which experiences in various situations of the organization is either systemic or may occur suddenly. The research focused on RBV is a theory that emphasizes on identifying and defining information system (IS) resources and relationships with CA (Competitive Advantages), SCA (Sustained Competitive Advantages), which is a strategic management and is used to monitor system performance. (Bharadwaj, 2000; Clemons & Row, 1991).

Information System (IS) resources are classification. J. W. Ross et al. (1998) categorizes IS resources as human resources, such as (1) IT skills, study the business understanding problem solving. (2) technology resources, such as hardware, software, databases architecture, and server system etc. (3) relationship resources, such as business relationships, level of management support, risk management, and responsibility etc. Information technology (IT) process is regarded as the ability to refer to the capacity of the system which helps to plan effective operations and market response. Bharadwaj et al. (1999) defined IT capabilities in six areas: Business IT Collaboration, External IT links, Business Strategic, IT Integration, IT Management, and IT Infrastructure. In addition, Bharadwaj (2000) has developed the concept of IT that it is the ability of the organization and IT data sources determination in the form of IT infrastructure. In addition to identifying IT resources types, Bharadwaj evaluated his IT capabilities and performance that, "High IT Capability business Tends to perform better". In addition, Day (1994), Wade and Hulland (2004), they showed that the ability of information can be classified IS resources into three categories (Day, 1994) in the framework of (Wade & Hulland, 2004) as follows: (1) Internal processes to the external: IS infrastructure, technical skills, and IS operations which is effective. (2) sponsions includes IS business partnerships, planning and change management. (3) external processes into the internal: external relationship management; market response etc. In agreement with this classification, propose that external resources and sponsions have a greater impact than internal resources on the sustainability of Competitive Advantage. Based on the concept of Nooteboom, Berger, and Noorderhaven (1997), he explained that data potential results from an understanding of the organization that is transformed into a process of continuous operation and openness for organizational development. However, this concept is also ambiguous. There are some deals about the potential of the organization which needs to



develop more in the competition. The concept of Hauknes (2000) describes that capability is the ability or the performance of a quantitatively measurable organization. That the organization will have high capacity is dependent on other resources apart from the competency of the personnel, there are also other resources such as machinery, technology, equipment, tools needed. According to the concept of the European Commission (G. Ross, 1993) it describes that the capacity of an organization influences the organization's strategic goals setting. In the same time, every organization needs to know how their capabilities are in production or provision of services. If considering backward, the capabilities we have, are they enough to support the needs of today's customers and that will grow in the future? Besides, are the capabilities sufficient to make the organization improve performance and efficiency and how? From McClelland's idea (1973), performance is the relationship between excellent performers in the organization and the level of knowledge, skills, and capability, and says that the measurement of ability of intelligence quotient, and personality test are not appropriate enough to predict the ability or performance of a person, because such information does not reflect the real talent. In agreement with the concept of Boyatzis (2008), it is found that competencies include knowledge, skills, abilities, and other attributes necessary for the responsibility such as the ability to provide services as the recipients need. Individuals need to have important components, both in job knowledge and related skills. such as the ability to search for information from a computer. Personality features are patience, gentleness, like helping others etc.

These features will result in superior work efficiency. Organizations must be able to leverage their individual capabilities in each position, both vertical and horizontal positions to provide human resources management in line with the vision of the business concrete. In line with Parry's (1996) concept, competency is intrinsic leading to the cause that makes the work more effective and he emphasizes that "the features that are inside are skills, not behavior" because it is defined within that person resulting in differentiation in accordance with different environments when defined from within. The use of capacity is regarded as an important element to the success of the organization in accordance with McClelland's concept (1973), it is found that the ability to cover the knowledge, skills and attributes needed to perform the task affecting the success in compliance with

satisfaction standard, which reflects the expertise, experience with appropriate and sufficient qualification for the work to be accomplished by building the capacity of personnel with training and development.

In conclusion, "Performance" is an important tool in developing knowledge, skill, and ability in individuals, resulting from the motives, habits, attitudes, adequate and appropriate values for the situation at that moment to apply to achieve the desired goal more effectively than the competition. This enables the personnel throughout the supply chain to utilize the information capabilities accurately, appropriately, worthily and timely. Based on the data from the Wisconsin Association of Academic Librarians (2001), the standard definition of information literacy and the importance of information literacy that, "In rapid change conditions, organizations need to help information users aware and appreciate the use of information to develop their own work in the departments and provide different benefits of other departments throughout the supply chain, and make information users be able to access, value evaluate, system setting, synthesize, and collect information from sources and a variety of information resources until they use shared information across the organization leading to learning and studying the information derived from the ERP system to help in the implementation." The ability of the standard information of the Wisconsin Librarian Association includes 10 capabilities as follows:

- 1) Can distinguish and describe the information needs required to solve the problem.
- 2) Can diagnose, identify and appropriately select sources of information.
- 3) Can plan information retrieval efficiently.
- 4) Can explain, analyze the results of the search and select the source of information that meets the needs.
- 5) Can identify sources and retrieve information on the required topics from various sources.
- 6) Can evaluate and select information.
- 7) Can organize, synthesize, compile, and apply the information.
- 8) Can determine the guidelines to seek information on their own.

9) Have an understanding of the sources and information resources in terms of composition, production process, Institute of Information and Communication Services.

10) Have ethics in using and disseminating information.

Eisenberg and Berkowitz (1990), (cited by Chowdhury & Chowdhury, (2001)) discusses the six steps to seek for the ability of information "The Big Six" information skills, which the users of information need to practice for skills in doing research. There are:

1) Skills to Determine the Subject to be Searched

Considering the subject to be researched to understand exactly what relevant information to look for, what information needed, start with understanding clearly the key points needed to study, what are the problems of the key issues? Take the problem questions to cover the key points to study (Who? What? Where? When? How? Why?) Selecting a topic to study, finding out what answers you want to find, What I would like to know? What I have already learnt?). When considering the subject to be studied well, the next step is to determine what information to look for, and prepare a search plan, practice to consider the matter to study, in order to use the information ability to the most useful and effective.

2) Strategic Planning Skills in Retrieval

When you understand what you want to study clearly, the next step is to plan information retrieval. At this stage, the researchers must understand the sources of information, which includes document, institution or expert, both demand and supply, relevant to and the operations of the organization and they have to know how to use information retrieval tools such as the Intranet, the Extranet, the Internet, electronic databases. Index and Abstracts. Information researchers must learn how to use computer programs, how to use search and retrieval commands.

3) Search and Access Skills

After determine the information retrieval plan, it's time to search in practice. Information may be available in a variety of information resources, such as published resources, including operational reports for each department, or not a published resource such as electronic databases, CD-ROMs, VDO and the Intranet, the Extranet, the Internet.

These information resources have different ways to search and access. Therefore, information users for the search need to learn and practice using different programs and information retrieval tools. They also need to know what kind of information they are using, such as searching offline databases in a CD-ROM or online database, they will get abstracts, or may be a full text, but if they search from the World Wide Web (www) on the Internet, they will get news, modern articles etc. These information sources above provide a way to access information differently in details to gain skills and be able to access to a wide variety of information quickly and easily.

#### 4) Information Technology Skills

The ability of information found may have different styles and presentation methods. They may be texts, numbers, or tables. Some information is drawing, photo, sound, and videotapes, researchers must learn how to use the information. Also, they must practice using specialized information resources to develop skills, such as maps, electronic database, multimedia etc.

#### 5) Information Synthesis Skills

Information synthesis refers to grouping and building information relationships, filtration and summarizing the information in each subject or concept which having been analyzed from one or more sources. Then re-presented in a completely revised appearance, which new layout will be made up of related issues from a broad subject to a specific subject.

#### 6) Information Evaluation Skills

The information found from various sources is both relevant and not relevant to the needs, there are differences in accuracy, modern, and the reliability of information. Therefore, there must be an evaluation for selecting valuable information and really using it. Consequently, all departments' workers of the organization and partners must be trained to be able to select good, valuable and useful information.

Therefore, that the organization will be able to retrieve data capabilities within the ERP system to maximize the benefits and efficiency throughout the supply chain requires a tool and form of integration of information that is accurate, suitable, timely, and in line with the true needs of each department. Each organization may have its own specific competitive strategy which depends on the internal resources and capabilities of

the organization, which is higher than the competitor or the competitor does not have the resources and capabilities we have. Supply Chain Managements System produces higher benefits such as information exchange, planning, and collaboration in improving working relationships, and effective communication, leading to the improvement of business performance (Chen & Paulraj, 2004) and the competitive advantage (Mentzer, Flint, & Hult, 2001) as well as Resource Based View Theory.

J. Barney (1991) and Grant (1991) have argued that the resources and capabilities of organizations are the driving factors of the organization's competitiveness as well. The researchers then have adopted Supply Chain Management and Resource Based View Theory concepts to enhance the competitiveness of the organization, giving importance to Demand and Supply Environment, too. Competitive advantage is the ability to compare one organization with others in term of operations. The competitive concept of Waheeduzzaman and Ryans Jr (1996) consists of a perspective on competitive advantage and price competitiveness, strategic view and management, and historical and social views. M.E.Porter believes that the determinants of competitiveness to support the growth of the manufacturing and services sectors are based on macroeconomics, which plays an important role in improving efficiency. Upgrading competitiveness can be analyzed in two forms: 1) Complexity and modern in business administration, and the strategies of the company. 2) Quality and quantity of environmental factors of the organization. Showing that, the organization will be highly competitive depends on the potential and competitiveness of the organization. If the ability to compete is high, it will have good productivity, efficacy, able to compete with competitors in the same industry, which require transformational leadership of the management influencing supply chain management practices and their ability to integrate knowledge. Moreover, there should exchange knowledge in product development within the group and between groups to have the competitive advantages. The ability to integrate knowledge in customer supply chains (K.-C. Kim & Im, 2002) has effect on linking to partnering strategies with suppliers of raw materials or goods. Information sharing and quality of information sharing, and customer relationship provide the organization with supply chain management practice. which is a partner management activity and the exchange of

information for good communication in the long run, both the shippers and the customers, under the drive of the executives, whose leadership is the factor to support the effective supply chain management (Wen et al., 2011). Specifically, transformational leadership enables the followers to have confidence to achieve their goal (Dvir, Eden, Avolio, & Shamir, 2002). Focusing on Entrepreneurial Orientation, which the factor of the environment of each supply is capable of producing and developing differentiated goods due to the variety of raw material production sources that influence the guidelines creation of a supply chain management. Therefore, the creation of an affiliate network of supply under different potentials taking such information to support each other and link the business operations together in the supply chain network, this will allow businesses to adapt to new opportunities and be ready to accommodate the potential impact of a competitive business environment, Ravichandran, Lertwongsatien, and Lertwongsatien (2005). Resource Based View theory is used to monitor how information systems (IS) work for the organization's existing resources, combined with the ability of human work which will affect the effectiveness and the performance of the organization. As a result, the organizations with potential, high performance and efficiency need to have correct and appropriate integration and application of information technology (IT) to support and strengthen the core competencies of the organization. The ability of the information system is a regular occurrence in the IS department that allows it to provide IT services to the organization. The core function of capabilities such as planning, system development, IS support, and IS operations. The capabilities can be identified and appraised using a standard functional classification of the firm's activities, and IS functional capabilities have been the focus of firm performance. Information system planning is an important process that enables organizations to identify business priorities and ensure that Information system goals and initiatives are aligned with business priorities. It is likely that with sophisticated Information system planning, a greater convergence between Information system and business management on IT priorities can be achieved (Boynton & Victor, 1991). For many organizations, continuity of business operations is dependent on efficient and reliable information system. Thus, organizations that do not have strong information system functional capabilities might find it difficult to initiate and sustain innovative project targeted at enhancing the firm's core

competencies or providing reliable information system services that might be critical for smooth business operations.

**Table 2.7** Summary of information capabilities

Author (s)	Summary
Mason-Jones and Towill (1997); (Chizzo, 1998)	The quality of information affects the sharing of information.
Kaleka (2002); Piercy, Kaleka, and Katsikeas (1998)	Information sharing is the capabilities of the organization
Kaleka (2002)	A partnership strategy with suppliers is the capabilities of the organization
Chang and Cho (2008)	Organizational Capabilities Affect Competitiveness
Winter (2003)	The ability of the information of the organization to perform an activity (Whether static, dynamic or creative) can be more effective than competitors.
(Bharadwaj, 2000; Eisenhardt, 1989; Grant, 1991; Makadok, 2001; Teece et al., 1997)	That capabilities have influence on organizational performance and capabilities are key determinants of it
Sanchez, Mahoney, Kirjavainen, and Thomas (2001)	The capability is another term that is widely used in RBV. While the concept of resources is developed.

## 2.5 Supply Chain Performance

Performance measurement is a useful tool for good decision making and is a key success factor for successful innovation (Soosay & Chapman, 2006). Performance measurement is an important part of effective supply chain management. Kaplan and Norton (2001) lead to good communication, good decision-making, motivation and transparency. (Regarding the entire supply chain) To meet the needs of modern management, effective measures have a positive impact on supply chain management because it helps to understand the entire system, affecting the behavior of members and partners with Partners and stakeholders in the current situation. (Fawcett & Clinton, 1996).

Supply chain performance measurement is important. The organization focus on using the resources and all information in each department for planning to achieve the objectives set, to be able to control the use of resources and integrated the information

capabilities to achieve objectives and make the right decision in the supply chain. Increased global competition, Organizations must understand how to better manage the supply chain in order to survive. Supply Chain Management (SCM) enables organizations to connect technology to people in an effort to adapt their technology to the capabilities of their organizations and partners to respond to customer needs (Antoniadis & Ananikas, 2004; CC Marinagi & Akrivos, 2011; Serdaris, Antoniadis, & Tomlekova, 2014). The increasing of supply chain performance is related to information integration, information capabilities of demand and supply environment to management issues, operations, information technology and sharing, customer service, and increase the competition capability, the level of supply chain integration and firm performance.

The supply chain performance depends on information integration of information capabilities of demand and supply environment in the enterprise resource planning system must more important in long-term stages. When supply chain integration is completed, a company can focus on supply chain performance and competition capability of the frozen food industry in Thailand. Types of metrics to evaluate the performance of supply chains (Pohlen & Lambert, 2001):

- need to go beyond the limits of the company's business.
- lack of metrics covering the entire system of cooperating links.
- need to determine the range of cooperation in between cooperators.
- complexity of processes.
- need for information exchange in order to achieve objectives.
- need to broaden the perception of supply chains.
- distribution of costs and benefits among the partners.
- need to diversify supply chains.
- encouragement to develop cooperation in order to improve processes.

Other authors also notice that there are no methods for measuring the performance of supply chains as a whole and this can cause them problem and stress, the metrics and indicators applied do not reflect the complexity of processes (Caplice & Sheffi, 1995) and the applicable criteria are not closely linked to the supply chain strategy (Lapide, 2010). Despite efforts to integrate a supply chain, the measurement aspect gets out of this coordination. Supply chain measurement is not a single coherent system but



actually a model of measuring the performance of individual companies as if they worked independently. Each link in a supply chain has its own system. What is worse, often the same aspect of measurement is interpreted differently by individual companies. Therefore, it is absolutely necessary to use the same terminology and apply common metrics, which are understandable for all cooperating links and which really measure the performance of the entire system adequately. Supply chain performance depends on the interaction of processes from upstream (farmer or supplier perspective) to downstream (customer or consumer perspective). This supply chain will be effective when being synthesized and confirmed beneficial benefits (Prajogo & Olhager, 2012) with emphasis on success (Flynn et al., 2010). Key factors affecting supply chain performance include the management and integration of capabilities of information to monitor and follow-up information flow, in terms of raw materials, products, and services, which is considered a strategy that is conducive to the production process, inventory management, efficient distribution and customer satisfaction. In the fiercely competitive business sector, there are some barriers that cause business adaptation, such as separating businesses from suppliers and other members of the supply chain. This may cause lack of competition or low bargaining power to the organization. So, the relationships and cooperation between each other within and between organizations are particularly useful. The development of supply chain management is the link between the business organization and the customers, suppliers, distributors, warehouses, and other members in the supply chain. In addition, development of effective supply chain management helps create business value that impacts on sustainable economic, social and environment (Msimangira & Venkatraman, 2014; Varsei, 2016). Organizations should integrate capabilities of information for valuable utilization in order to better respond to the customers' needs. But must aware of the driving force behind supply chain efficiency which is the integration of capabilities of existing information to gain accuracy, completeness and in-time, in order to be used as a basis to support decision-making in a timely manner, under controlling and monitoring of information flow to link to activities and operations in the same supply chain together. Therefore, the integration of capabilities of information is considered the most influential factor to the performance of the supply chain and effects other factors driving the supply chain (Mazzawi & Alawamleh, 2013).

For the relationship of supply chain efficiency to meet the needs of customers, many business organizations have creative business processes in their supply chain and lead to competitive advantages such as:

- Walmart, a large retail company in the United States and many countries around the world, uses information technology to link and exchange information with manufactures, which are suppliers, throughout the supply chain, and make warehouse or distribution center responsible for receiving and delivering the goods from one vehicle to another. Delivery time is less than 24 hours (cross-docking) which help reduce costs and be able to delivered quickly to the customer (Reiner & Hofmann, 2006).

- Dell, leading US computer company, uses information technology to connect manufacturers and customers at various levels within the supply chain which enhances responses to various kinds customer needs (Reiner & Hofmann, 2006).Data sharing by integration of capabilities of information. (In all the activities of each department within the same industry) between members in the supply chain will lead to competitive advantages including adding value to the product delivered to the customer and the reducing supply chain costs (Mazzawi & Alawamleh, 2013). The exchange of information between the organizations is an important role at all levels of the organizations that work together in the supply chain, and leads to effective response to customer needs (Sharma et al., 2013).

Definition and integration of supply chain information is the process of complex networks of business units within each organization. This has to do with the flow of information containing product and service information from upstream to downstream (Felea & Albăstroi, 2013; Lambert, Cooper, & Pagh, 1998). These business enterprise networks are composed of producers, suppliers of raw materials, service providers, distributors, wholesalers, retailers, other middlemen and customers (Felea & Albăstroi, 2013). In the supply chain of each organization, there will be working together processes to change raw materials to products and deliver them to customers. There may be coordination between organizations or partners to create physical, information, and financial flow connections. The supply chain is involved in both direct and indirect processes in response to customer needs, including product development, marketing, finance, and customer service (Chopra & Meindl, 2001). Supply chain is a group of

organizations or individuals involve in the flow of goods, services, finance and information in upstream or downstream direction. Supply chain can be divided into 3 levels, direct supply chain which consists of one company, one raw material supplier and one customer. Extended supply chain covers raw material suppliers and customers in the next tier. Ultimate supply chain covers every organizations or sections involved in the flow of goods, services, finance and information, back to the first raw material supplier and forward to the final customer (Mentzer, Flint, et al., 2001). Thus, the summarized concepts are as following. Information of demand and supply environment in the ERP system must be integrated between information integration and information capability from each department for increasing the supply chain performance and increasing the competitive advantage. For instance, to showing the relation of factors driving supply chain to respond to the customer requirements and supply chain performance. Many organizations have creative business processes within their supply chain which lead to competitive advantage, for example, Wal-Mart, Dell, Zara are world big companies that can widely use information in order to create network of retail managers, design manager, and manufacture manager for efficiency corroboration (Reiner & Hofmann, 2006). Sharing information between members in the supply chain will lead to competitive advantages in increasing the value of products delivered to customers and reducing costs in the supply chain (Mazzawi & Alawamleh, 2013). Information exchange among the parties plays a very important role in every level of structures in the supply chain and leads to effective respond to customers' needs (Sharma et al., 2013). In general, a business organization is often split operation. Each section will work independently. In this way, the organization cannot meet the needs of customers effectively. The concept of supply chain integration focuses on engaging activities and processes together without a seam. Integration can be divided into two categories.

- 1) Internal supply chain integration, which is a collaborative process of activities and processes within an organization. Internal supply chain integration aims to break down barriers among various units within the organization to create network, communication and increase support exchange among each other including procurement, production planning, warehouse management, distribution management, and customer relationship management (Hogan et al., 2011). Many large companies focus on supply

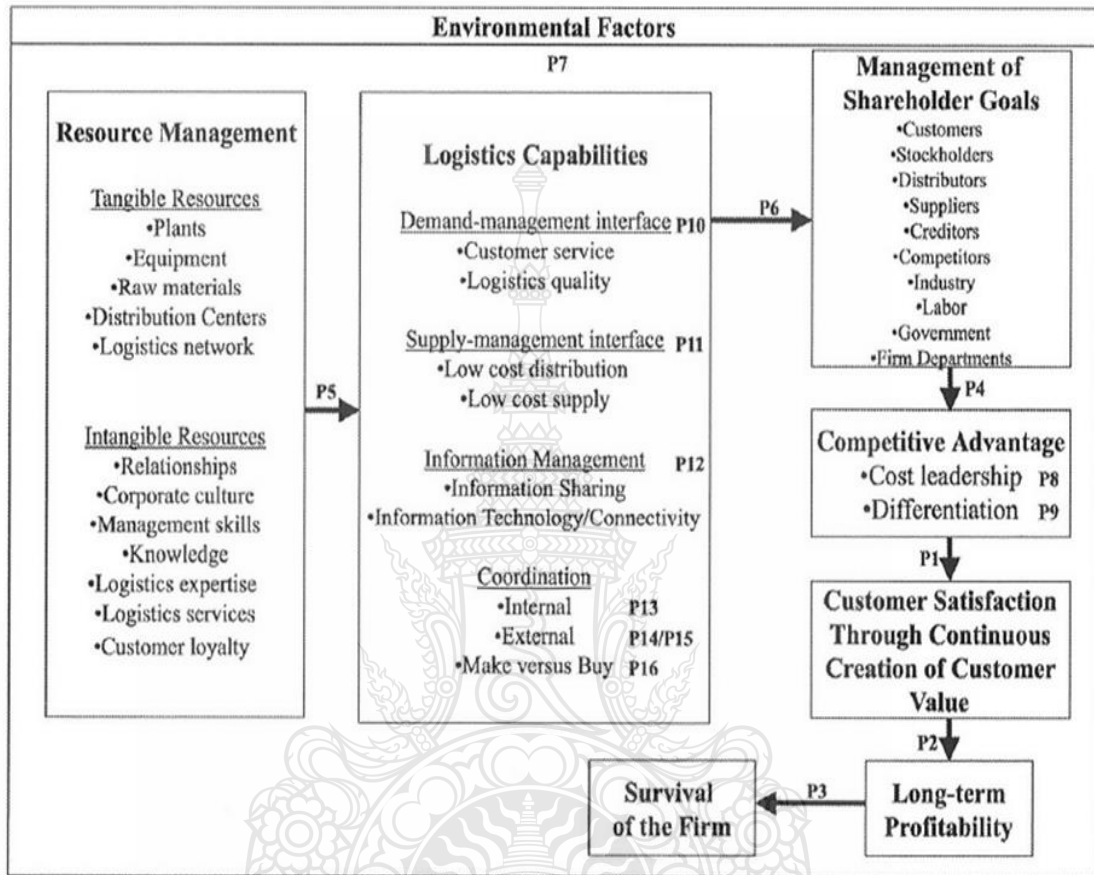
chain management by appointing a vice president or director for supply chain management, mainly responsible for main tasks of the supply chain such as operation, procurement and logistics (Verma & Boyer, 2010).

2) External supply chain integration. Supply chain is a network of organizations linked together to achieve target of each organization. Upstream and downstream supply chain management enhance competitive advantages by having better products or services (Verma & Boyer, 2010). External supply chain integration is a network construction among organizations, including suppliers, customers, products, and services delivered to the final customers. For organizations within the supply chain, if any organization is not operated effectively, it will make the whole supply chain impossible to compete. If consider in competition perspective, will find that there is a shift from competition among business to competition among the supply chain (Hogan et al., 2011).

## **2.6 Theoretical Framework**

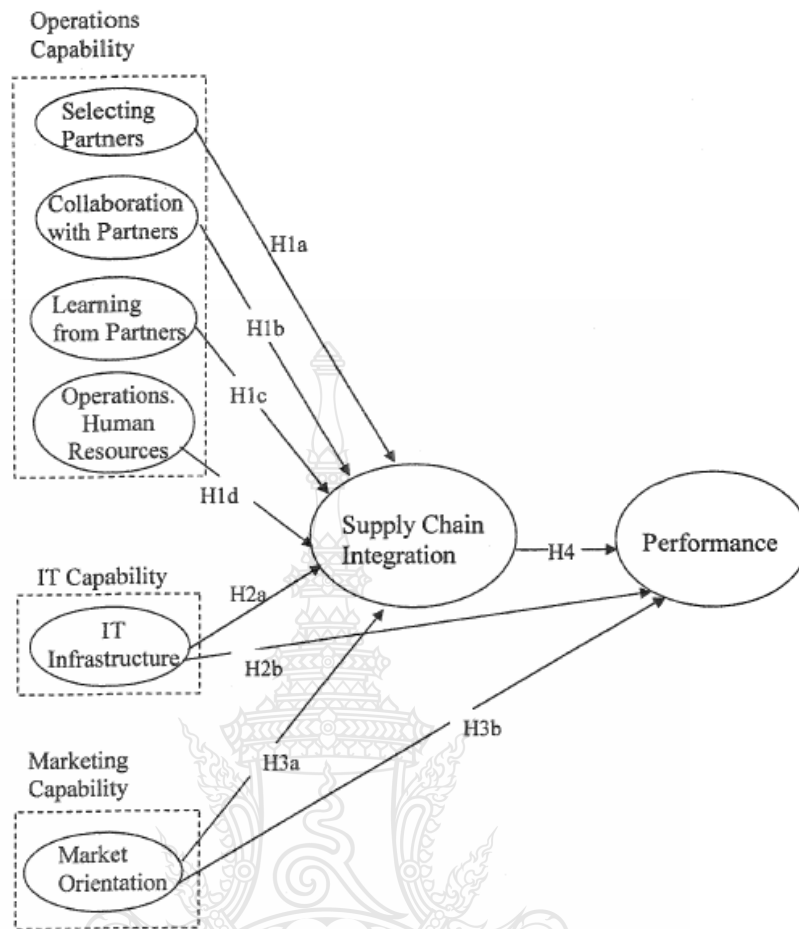
Information capability management can be able to create competitive advantage is a focus on information integration that helps companies develop and increase supply chain capabilities (Fawcett & Clinton, 1996). Morash, Droge, and Vickery (1996) said that talent is a special feature caused by the learning process and the ability to integrate the learning process from knowledge and skills that are human helping the company to achieve efficiency beyond expectations of competitors. Integrated information capabilities for each department to be integrated together. For analysis and grouping of information that will be used for maximum benefit. Therefore enhancing the efficiency of the supply chain system which must be planned from company's strategic policy level. Lambert et al. (1998) the supply chain management system that uses information in the ERP system will help all relevant parties to have initial data for analysis and planning to improve competitiveness and competency. In the profitability of the company Lynch and Lynch (2000) study about the relationship between operations, logistics and excellence in talent and organizational performance. Mentzer, DeWitt, et al. (2001) offered the comprehensive view of capabilities in a unified theory of logistics (as shown in Figure 2.1), together with theoretical explanation of each capability of logistics. However, the

proposed theory was a one way to challenge and refine their proposed view of logistics is encouraged.



**Figure 2.1** Unified theory of logistics (Mentzer, Flint, et al., 2001)

The consistent with Seuring and Müller (2008) analyze the supply chain capabilities that affect supply chain integration and company performance. Show that Infrastructure spending Information technology and the ability of the information to be used is highly correlated with the integration of the supply chain and has a positive impact on supply chain integration company performance.

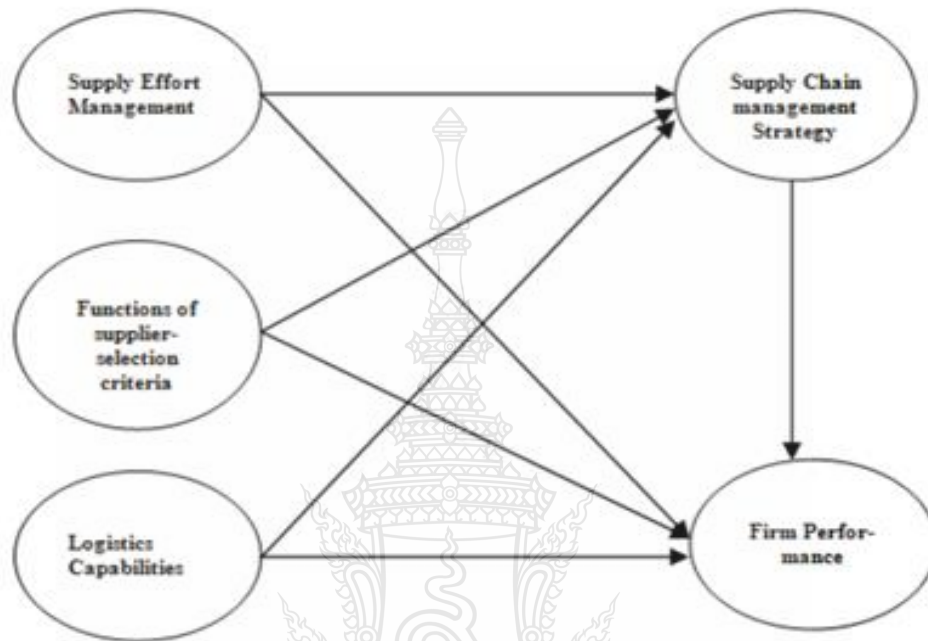


**Figure 2.2** Research model for the relationship of supply chain capabilities, supply chain integration and firm performance (Seuring & Müller, 2008)

These studies lead to the information integration and information capabilities in ERP system to increase the supply chain performance, and the 5 hypotheses (H1 H2 H5 H6 and H7) for in the study.

The study of Sezhiyan and Nambirajan (2011) examined the relationship between duties in selecting suppliers. Is an attempt to provide supply chain capabilities, consider the supply chain management strategy and the company's performance. The survey was conducted with the supply chain experts within the company. (Management of procurement efforts, the ability to choose suppliers, logistics capabilities and supply chain management strategies) affect the company's performance. There are three

interesting variables that can be used to Predictable management Procurement efforts (Eg, long-term and strategic relationships of suppliers, supplier engagement and supplier quality selection) have a significant impact on operational efficiency than other companies.

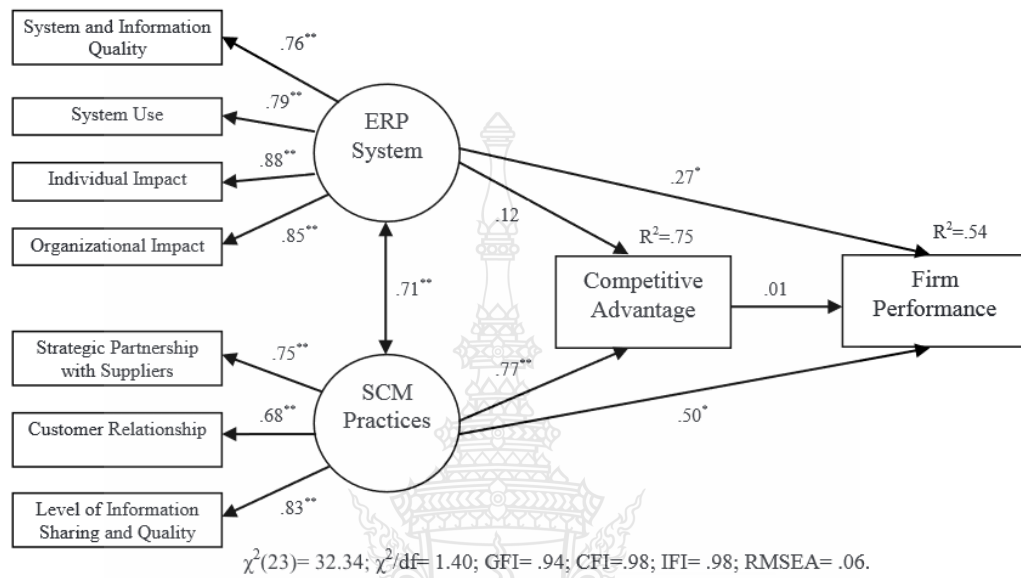


**Figure 2.3** Research model for the relationship of supplier selection, supply effort management, logistics capabilities on supply chain management strategies and firm performance (Sezhiyan & Nambirajan, 2011)

These studies lead to the information integration in the ERP system and demand and supply environment to increase the supply chain performance. and the 3 hypotheses (H2 H4 and H7) for in the study.

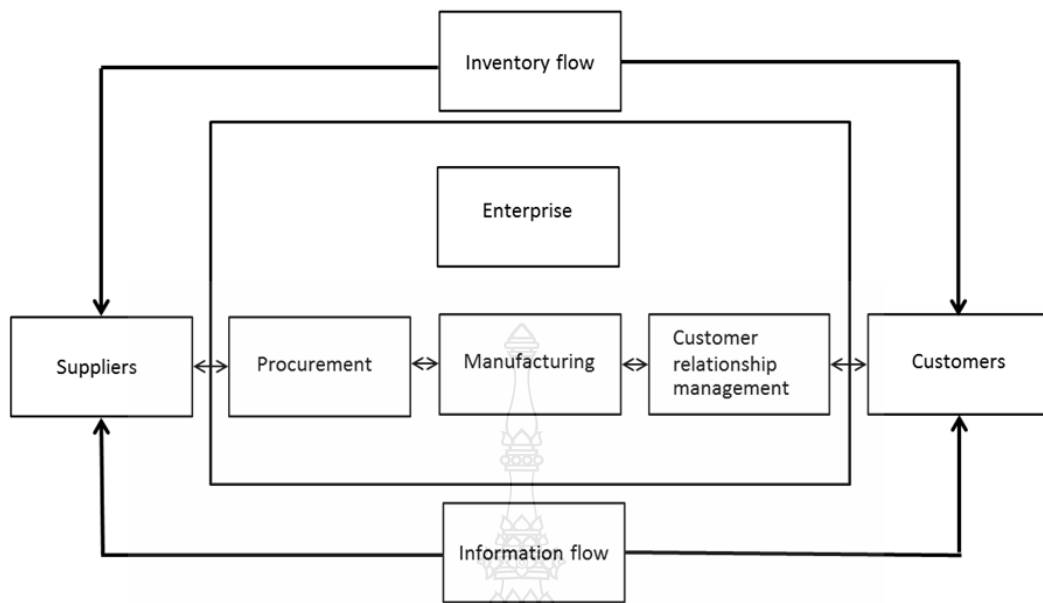
The consistent with, Ince, Imamoglu, Keskin, Akgun, and Efe (2013) Enterprise Resource Planning (ERP) is an important tool for business process planning. Data flow, operation and position control used in various locations. Supply chain management (SCM) is the gateway to external companies for mutual benefits in their own processes. Operations and integration of ERP and SCM systems at success is considered an advantage in planning, decision-making, operation and optimization of the company. This study examines the size of the SCM and ERP systems and tests the relationship between

competitive advantage and company performance. It is found that the implementation of SCM and ERP systems has a positive effect on the efficiency of the company and can create gain competitive advantage.



**Figure 2.4** Research model for the impact of ERP systems and supply chain management practices on firm performance: case of Turkish companies (Ince et al., 2013)



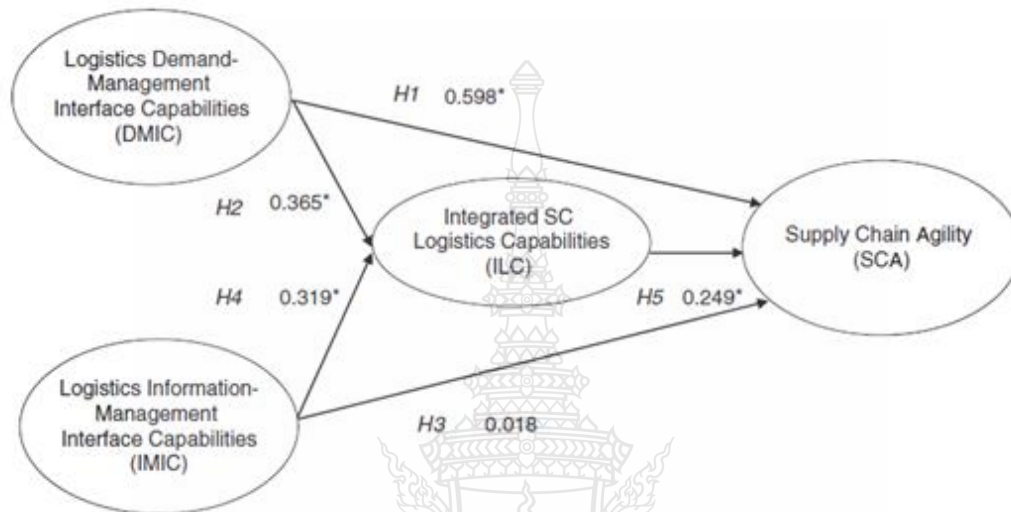


**Figure 2.5** Logistics operational scope (Bowersox, 2013)

Thus, the operation within the organization. It can be divided into three areas: (1) Customer relationship management with different characteristics of customer service through the customer relationship management process (2) Production is inventory management of work processes and (3). Procurement related to the procurement and delivery of incoming raw materials from the seller. All three general organizations overlap management functions. In order for each part to be part of creating an overall value that will increase throughout the supply chain process, organizations can use specific features of each department to create a competitive advantage for the organization. The key challenge is to integrate information with the management process of each department to achieve relevance in the organization that facilitates overall efficiency.

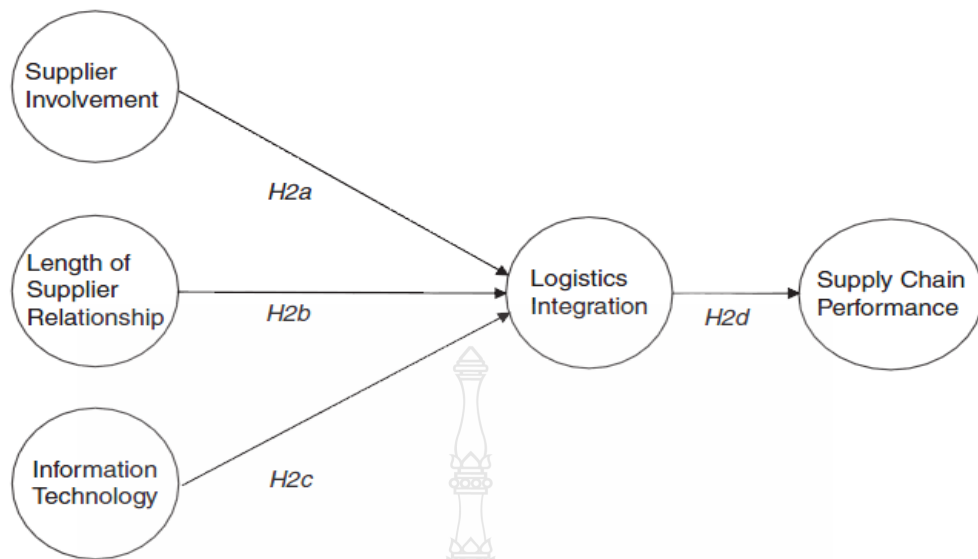
Furthermore, M. Gligor and Holcomb (2014) study the relationship between logistics management capabilities, logistics management capabilities and supply chain agility through logistics capabilities. From the research, it is found that demand management affects the agility of the supply chain. Demand management found that direct involvement with the level of integrated transportation capabilities, data

management capabilities did not directly affect the agility in the supply chain. But received full cooperation from integrated transportation capabilities the research results show that the relationship between logistics capabilities depends on logistics and integration capabilities.



**Figure 2.6** Research model for the relationship of logistics demand management integrated logistics capabilities, logistics information management capabilities and supply chain agility (M. Gligor & Holcomb, 2014)

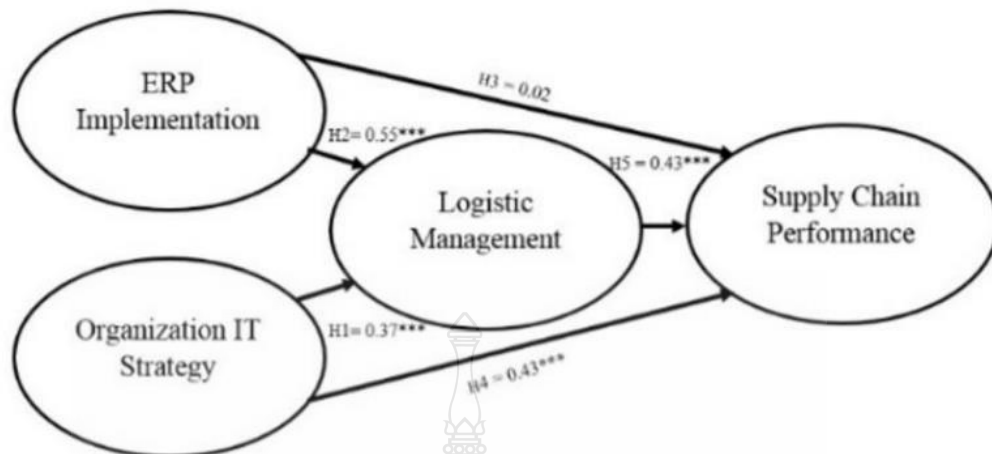
Therefore, Alam, K. Bagchi, Kim, Mitra, and Seabra (2014) analyze the relationship between logistics capabilities, including supplier engagement, long-term relationships with suppliers and IT use and efficiency. From the supply chain of the company, the study shows that all transportation capabilities do not directly affect the efficiency of the supply chain. However, the ability to integrate the logistics system directly affects the efficiency of the supply chain.



**Figure 2.7** Research model for the relationship of logistics capabilities namely, supplier involvement, length of supplier relationship, and the use of IT and firm's supply chain performance (Alam et al., 2014)

These studies lead to the information capabilities in the ERP system and demand and supply environment to increase the supply chain performance. and the 4 hypotheses (H1 H3 H5 and H7) for in the study.

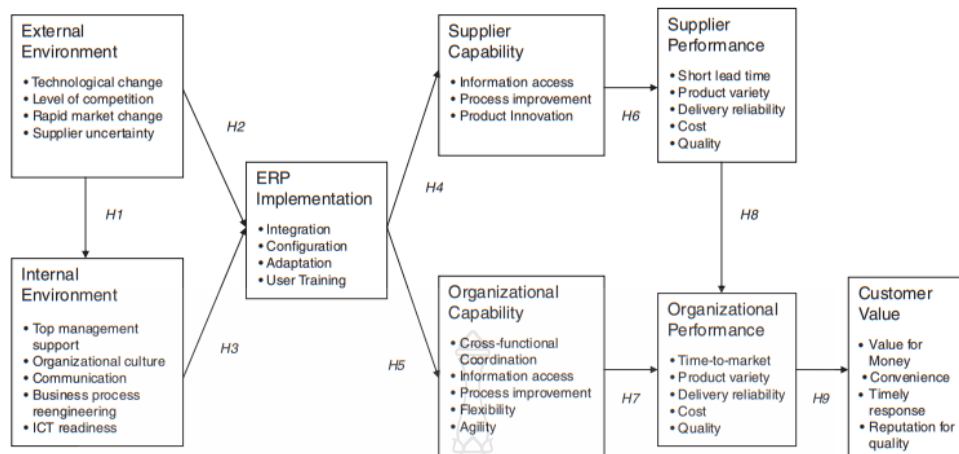
The research is consistent with Srisawat and Jaturat (2016) research to study and test the influence of Implementing ERP systems and corporate IT strategies for supply chain management performance via the mediator is logistics management. Study for participation in supply chain management performance follow to the hypothesis in H1, H2, H3, H4 and H5. The investigation will be carried out by leading companies in the food industry of Thailand. It is found that ERP implementation and corporate IT strategies in the food industry also. Performance of Supply Chain Management must consider the importance of management factors. Logistics on traceability, transparency, reliability and time management for transport processes. However, if the food industry is more interested in the use of ERP and IT strategy of the organization under the module of logistics. Such management will benefit the organization supply chain management efficiency In this case. The research has been consistent and supports in the study of ERP implementation and corporate IT strategies for optimizing supply chain management in the future.



**Fig**

IT strategy on supply chain performance through logistic management : a case study of food industry in Thailand (Srisawat & Jaturat, 2016).

In addition, Nurizman and Singla (2017) study the success in Supply Chain Management. Conduct surveys with senior management, general managers, executives or production managers, purchasing managers, logistics managers, material managers, quality managers, marketing managers and financial managers. Before testing the hypothesis, the results showed that the practice of SCM helped increase the success of SCM practices while the barriers to implementation of SCM negatively impacted the success of SCM compliance.



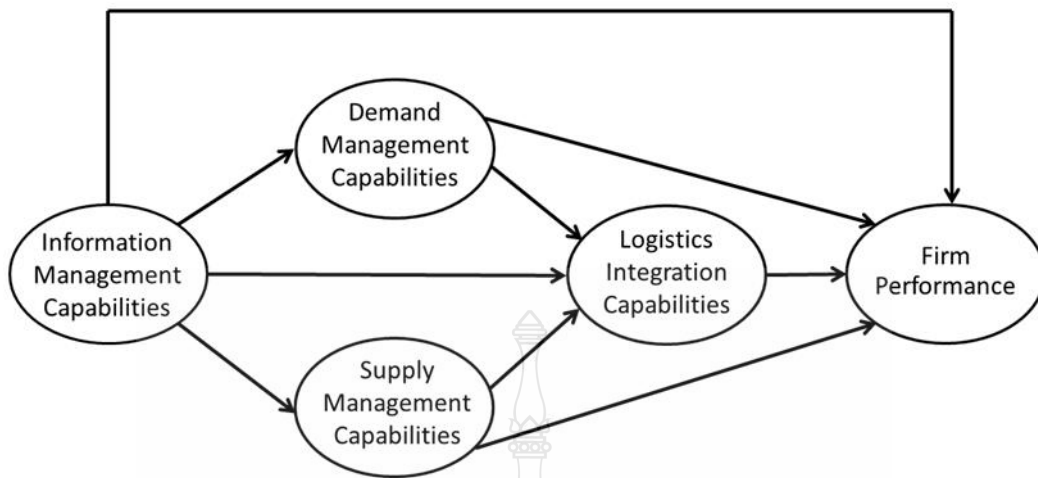
**Figure 2.9** Research model for the investigation of barriers and enablers

of supply chain management practices success:

case of Ethiopian textile and garment factories (Nurizman & Singla, 2017)

These studies lead to the information integration and information capabilities of Demand and Supply Environment to increase the supply chain performance. and the 5 hypotheses (H3 H4 H5 H6 and H7) for in the study.

Finally, Kitransikul (2017) study the information management process, when used the Information management capabilities, Demand management capabilities, Supply management capabilities and Logistics integration capabilities are the mediators to effect to firm performance. which found Information management capabilities, Demand management capabilities, and Supply management capabilities positively affect logistics integration capabilities. Therefore, Logistics integration capabilities have a positive impact on the performance of the food processing companies in Thailand.



**Figure 2.10** Research model for the a resource-based view approach on mediating of logistics integration capacities on firm performance an empirical study on the food processing industry in Thailand (Kitrangsikul (2017))

Although several studies suggest a significant and positive relationship between information capability and information integration for support the supply chain performance, there are still limited research efforts made on the study of how integrated information capabilities would impact firm performance. Most of the earlier studies were conducted with focus on specific factors or aspects of the logistics capabilities and logistics integration or supply chain integration. However, none, to the knowledge of the researcher, is found to be studied on information integration and information capabilities as the mediator between ERP System, demand and supply environment, and supply chain performance. The motivation for this study is to bridge the gaps by exploring relationship and examining effect of demand and supply environment in ERP system through the mediating model of information integration and information capabilities and the impact on supply chain performance. Other point of interest in this study is also to analyze relationship of information integration and information capabilities with other core functions, on how it would facilitate each core functions and as well as their direct impact on supply chain performance.

## 2.7 Research Model

According to the aforementioned theoretical background and several relevant empirical studies, the research model for the study has, therefore, been developed as illustrated per below. ERP System and Demand and supply environment are independent constructs, Information Integration and Information Capabilities represent the mediating construct, and Supply Chain Performance is the dependent construct.

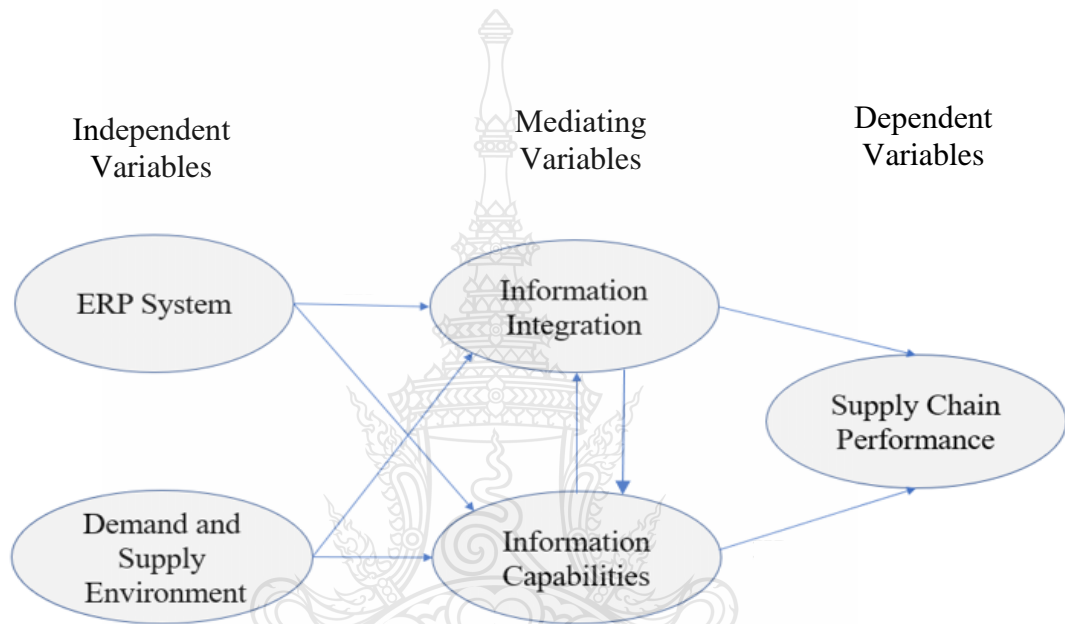


Figure 2.11 Research Model

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

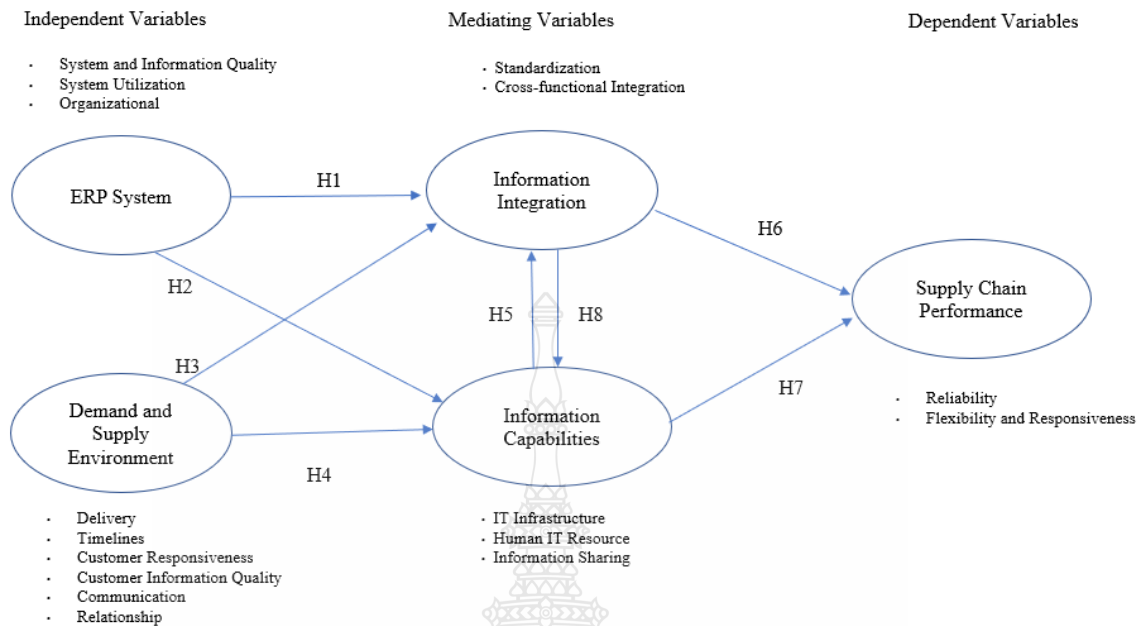
The following chapter describes research methodology that has been used empirically to test hypotheses developed in the preceding chapter by analyzing the relationships between enterprise resource planning system and demand and supply environment are independence, the information integration, the information capabilities as a mediator, and the supply chain performance construct. The chapter comprises of five sections, the first section introduces the hypothesized structural model, the second section outlines the research design and the setting of the study, the third and the fourth section specify the quantitative and qualitative methodology, and the last section discusses the sequence of analysis.

#### **3.1 Hypothesized Structural Model**

The proposed hypothesized structural model has been developed based on the aforementioned research framework and hypotheses in the preceding chapter (as illustrated in figure 3.1).

The study deploys Structural Equation Modeling (SEM) techniques as statistical tools for the analysis of the data in the study. SEM is considered a second generation statistical approaches (Gefen, Straub, & Boudreau, 2000), which allows simultaneous analysis of multiple criteria and independent constructs. This advantage overcomes the shortcoming of the traditional statistical analysis especially with the model with more than one layer of relationship, where single analysis of each individual layer need to be done (Jain, 2007). SEM determines the structural model (of relationships amongst a set of independent and dependent constructs) as well as, the measurement model (such as loadings of observed variables to the latent variables) at the same time (Gefen et al., 2000).





**Figure 3.1** The proposed hypothesized structural model

### 3.2 Research Design and the Setting of the Study

This study is a mixed method research design. The quantitative research uses a cross-sectional, mail survey methodology and a questionnaire as instrument for data collection. The qualitative research involves in-depth individual interviews with organization’s key logistics personnel (e.g., logistics manager/director).

The setting of the study is the food processing industry in Thailand. The food processing industry has been selected for a couple of reasons. Firstly, Thailand is one of the world’s largest producers and exporters of food and processed food products. Food industry is one of key contributor to the national economy which accounts for as much as 25 percent of the GDP where 22.5% of which are processed food products. Secondly, it has been known of the crucial roles of supply chain in the food industry as supply chain performance involves in the movement throughout the process of the industry starts from acquire raw material, storage, put through the process and the delivery of finished goods to the customers. Supply chain of logistics helps the food industry to maintain a continuous supply of food products from different suppliers and distributors across various locations to the customers domestically and globally. Thirdly, the large

population of food processing industry in Thailand yields a large enough sample to provide a robust assessment of the hypothesized model. And lastly, the findings and implications of this study would support and strengthen the competitiveness of Thai food industry, which is in accordance with the “Value-Based Economy” economic model promoted by the Thai government.

### **3.3 Quantitative Methodology**

Qualitative methodology involves collecting, analyzing and integrating of the quantitative data. The study uses a cross-sectional, mail survey methodology and a questionnaire as instrument for data collection.

There are several advantages of mail survey have been recognized by researchers, such as relatively low cost, reliable, fast and cover a large and dispersed geographical areas and populations (Joong-Kun Cho, Ozment, & Sink, 2008). Mail surveys help the test measurement scales (Davis, Allen, & Cosenza, 1988) and also seek out and test relationships between variables (Dunkelberg & Sonquist, 1977), and validity checking (Kerlinger, 1986).

#### **3.3.1 Population and Sampling**

The key objectives of this study are to examine the relationships between core enterprise resource planning system, and demand and supply environment, the information integration, the information capabilities, and supply chain performance.

The target respondents are supply chain managers or directors in the food processing organizations in Thailand. These respondents are considered having adequate knowledge about company’s information capabilities and are in the roles that are able and will be willing to share the surveyed information, therefore, their answers are considered accurate and reliable. The study chooses to focus on one industry as it allows controlling external variables and providing reliable results for theoretical testing (Morash et al., 1996).

According to the United States Department of Agriculture (USDA), processed food is defined as any raw agricultural product that has been washed, cleaned, bitten, cut, cut, heated, pasteurized, blanched, canned, frozen, dried. Drying, mixing, packing or other processes that change food from natural conditions Which may include adding other

ingredients to foods such as preservatives, flavors, nutrients and other food additives or substances approved for use in food products such as salt, sugar and fat (<http://www.usda.gov/wps/portal/usda/usdahome>).

The study has assigned ten groups of population from the food processing industry in Thailand, based on the guidelines of industrial clustering provided by the Federation of Thai Industries. The sample size is calculated according to the rules of structural equation model (SEM). Bentler and Chou (1987) proposed a simplified guideline which provides the trustworthiness of solutions and parameter estimates, and advised that the ratio of “sample size” to “number of free parameters” under normal and elliptical theory, could go as low as a 5:1 ratio, particularly, in the study with many indicators of latent variables and with large factor loadings. The higher ratio, the more trustworthiness they are, although it is not evident of which to base a recommendation, a ratio of at least 10:1 may be considered adequate and appropriate sample size. The free parameter from the conceptual model is 23, the study thus targets the initial sample size to be 230 samples from food processing organizations in Thailand, distribution of sampling from each group is on weighted proportional basis.

**Table 3.1** The population and distribution of sample size

<b>Division of Thai Food Processing Industry</b>	<b>Population (N)</b>	<b>Sample (n)</b>	<b>Percentage</b>
Animal and processed meat product	215	26	12.09
Poultry products	151	30	19.87
Fishery and marine products	220	22	10.00
Milk and Dairy products	158	20	12.66
Fruits and Vegetable Products	283	29	10.25
Fat and oil products	298	27	9.06
Food products made from flour	241	16	6.64
Condiments and seasoning ingredients	186	17	9.14
Beverages and drinks	284	28	9.86
Sugar and confectionery products	256	19	7.42
Total	2,292	234	100

### **3.3.2 Data Collection**

The total of 3,500 contact information of the food processing organizations is obtained from database of Department of Industrial Works under the Ministry of Industry of Thailand. Organizational data comprises of primary contact information, firm size, business sector, registered capital and year of establishment.

This study uses research methods to explore key participants in data collection. This method relies on one or two people to provide the information that is being explored. The principal contributor is considered qualified due to his position, experience and specific knowledge.(Venkatraman, 1987). This technique, although, has received some criticism of invalid data when only single respondent is used (Phillips, 1981), however, it has been advised that there is no other viable alternative in order gain information from top managers (John & Reve, 1982).

The key informant survey research strategy suggested that the key informants should be both knowledgeable about the issues being studied and willing and able to communicate this information (Campbell, 1955), the target respondents for this study are logistics managers or directors who are well aware of the business strategy, actively engaged in the company's logistics process and activities and are knowledgeable about logistics capabilities of the organization. These respondents are considered key informants.

The mail survey methodology is used to collect data to address the study's research hypotheses. The questionnaires will be sent to logistics managers/directors by mail. A mail package contains an introduction letter from the Rajamangala University of Technology Thanyaburi, an information sheet about the study, a questionnaire survey, and a postage-paid, addressed return envelope to the Faculty of Business Administration.

### **3.3.3 Research Instrumentation**

#### **3.3.3.1 Questionnaire**

A questionnaire consists of a series of questions and is designed to extract specific surveyed information from the respondents. Based on the literature review of the relevant study, questionnaire is aimed to fulfill research objectives and answer the research hypotheses. It was argued that with the large scale industry data collection, low

response rate has always been a potential issue, therefore, a well-designed and easy to fill out questionnaire helps to increase response rate (Fowler Jr, 2013).

The questionnaire for this study is thoroughly designed to address the research hypotheses formulated to develop a conceptual framework. The questionnaire is divided into six sections; Section 1: Enterprise Resource Planning, Section 2: Demand and Supply Environment, Section 3: Information Integration, Section 4: Information Capabilities, Section and 5: Supply Chain Performance.

Thus, Section 1 of the questionnaire is focused on the Enterprise Resource Planning System, the construct is measured by system and information quality and system utilization with the objectives to measure the firm's abilities to combine demand's and supply's need with supply chain capabilities, as well as the abilities to plan and forecast/predict, and manage the demand for products, delivery and services to meet the requirement of the customers and fulfill customer satisfaction. The following Seven-point Likert scales ranging from 1 to 7, are used to rate each question, where 1 = Strongly Disagree, 2 = Quite Disagree, 3 = Slightly Disagree, 4 = Neither Agree nor Disagree, 5 = Slightly Agree, 6 = Quite Agree, and 7 = Strongly Agree.

Section 2 of the questionnaire is focused on the Demand and Supply Environment, measured by delivery, timelines, customer responsiveness, customer information quality, communication, and relationship with the objectives to measure the firm's abilities to effectively manage of supply-chain partnerships using process planning, evaluating, implementing, and controlling strategic and operating sourcing decisions. The following Seven-point Likert scales ranging from 1 to 7, are used to rate each question, where 1 = Strongly Disagree, 2 = Quite Disagree, 3 = Slightly Disagree, 4 = Neither Agree nor Disagree, 5 = Slightly Agree, 6 = Quite Agree, and 7 = Strongly Agree.

Section 3 of the questionnaire is focused on the Information Capabilities, measured by IT infrastructure and Human IT resource with the objectives to measure the firm's abilities to acquire, deploy and leverage the IT assets, use and provide data and information to users at appropriate levels and to coordinate informational resources and put them into productive use, as well as to adapt to responses to changing market needs and directions. The following Seven-point Likert scales ranging from 1 to 7, are used to

rate each question, where 1 = Strongly Disagree, 2 = Quite Disagree, 3 = Slightly Disagree, 4 = Neither Agree nor Disagree, 5 = Slightly Agree, 6 = Quite Agree, and 7 = Strongly Agree.

Section 4 of the questionnaire is focused on Information Integration, measured by standardization and cross-functional integration with the objectives to measure the firm's practices and operational activities in the supply chain which organize and coordinate the flow of materials and information throughout the value stream from suppliers to customers which connects the cross-boundary activities and functions. The following Seven-point Likert scales ranging from 1 to 7, are used to rate each question, where 1 = Strongly Disagree, 2 = Quite Disagree, 3 = Slightly Disagree, 4 = Neither Agree nor Disagree, 5 = Slightly Agree, 6 = Quite Agree, and 7 = Strongly Agree.

Section 5 of the questionnaire is focused on Supply Chain Performance, measured by reliability and flexibility and responsiveness with the objectives to measure the effectiveness and effectiveness of the company in the supply chain to achieve the intended objectives. The following Seven-point Likert scales ranging from 1 to 7, are used to rate each question, where 1 = Strongly Disagree, 2 = Quite Disagree, 3 = Slightly Disagree, 4 = Neither Agree nor Disagree, 5 = Slightly Agree, 6 = Quite Agree, and 7 = Strongly Agree.

The last section is a survey for the demographic and background characteristics of the respondents including age, educational qualification, as well as the working experiences in the supply chain functions and responsibility for the purposes for respondent analysis.

#### 3.3.3.2 Testing on the Response Bias

In this study, the questionnaire is used as an instrument to survey the attitude of the target respondents towards the firm's logistics capabilities and the firm performance, however chances are that the respondents may provide inaccurate or untruthful response which is a "Response Bias". The research instrument for this study has been designed at best, on the methodology to detect and prevent respondent's social desirability and nonresponse biases.

Social desirability bias refers as a phenomenon where respondents provide socially acceptable answers or present in a more favorable way, especially in the surveys

which are not confidential. This could be that to avoid embarrassment or the reluctance to admit to undesirable attitudes. The social desirability bias can be avoidable with a proper designed questionnaire which represents no influence content. The researcher may also explain and give a clear objective and the results that would be expected from the survey. It could also be helpful to emphasized to the respondent that participation in the survey is done on behalf of the organization or job responsibility, rather than personal opinion.

Non-response bias refers to the situation that the target respondents do not return the questionnaire or unwilling to participate in the survey. It also refers as the situation where respondent's opinion is systematically different from the opinions of those who are willingly to participate and return the questionnaire for the survey. Mail survey has been criticized on the nonresponse bias (Baur, 1947). Lynn (1996) defines the two types of problem generated from the non-response. First, it reduces the size of the sample and therefore increases sampling error, and second, the creation of bias which resulted when respondents' opinions differ in meaningful ways from non-respondents.

The return rate of mail questionnaire must not be less than 20% to be acceptable (Aaker, Kumar, & Day, 2001). Non-responsive bias can be tested by comparing the characteristics of respondents who submitted completed surveys and non-responders who did not return completed surveys. (Whitehead, Groothuis, & Blomquist, 1993), to assess non-response bias in mail survey is to use statistical significance difference tests (Krause & Scannell, 2002), two sample t-test assuming equal variances for 10 percent of sample to compare between the early returned respondents and the follow-up respondents (Agan, 2005), if there is no statistical significant differences with t-test at  $p < .05$ , it suggests that nonresponse bias is not detected (Armstrong & Overton, 1977)

#### **3.3.4 Measurement Variables**

The attributes of the Enterprise Resource Planning are measured by three variables which are system and information quality, system use, and organization impact. The definition of each variable is presented in table 3.2.

**Table 3.2** Definition of the measurement variables for enterprise resource planning system.

Variable	Definition	Sources
System and Information Quality	The importance of quality of service offered by the data processing department. (Support) or an external service provider. It is important not to lose customers and cause failures.	DeLone and McLean (2004)
System Utilization	Sharing knowledge of the organization during operation Sharing tacit knowledge in the sand groups of project members and organization members. The dimension of corporate culture that facilitates the sharing of knowledge in ERP. The ERP system allows data that is linked to suppliers, distributors and customers without geographical restrictions. Information about customers and suppliers will be shared instantly and accurately and homogeneous manner	Chen and Popovich (2003)
Organizational	Workgroup: organizational units and/or functional departments and risk management are part of successful business management in the event of changes.	DeLone and McLean (2004)

The attributes of the Demand and Supply Environment are measured by six variables which are delivery reliability, timeliness, customer responsiveness, customer information quality, communication, and relationship. The definition of each variable is presented in table 3.3

**Table 3.3** Definition of the measurement variables for demand and supply environment

Variable	Definition	Sources
Delivery	The ability to deliver exactly the date and quantity specified or exact.	Morash et al. (1996)
Timeliness	The abilities to deliver at customer on timely fashion.	Morash et al. (1996)
Customer Responsiveness	The ability to meet the needs and needs of customers.	Morash et al. (1996); Mentzer, DeWitt, et al. (2001)
Customer Information Quality	Customers' perception on details and accuracy of the information available for products and services.	Lambert et al. (1998); Yuan, Zhang, and He (2015)



**Table 3.3** Definition of the measurement variables for demand and supply environment  
(Cont.)

Variable	Definition	Sources
Communication	The effective frequent, genuine and two-ways communicate between firm and suppliers.	Chen and Paulraj (2004)
Relationship	The close relationship between firm and suppliers which increases the intensity of coordination.	Chen and Paulraj (2004)

The attributes of the Information Integration are measured by two variables which are standardization, and cross functional integration. The definition of each variable is presented in table 3.4.

**Table 3.4** Definition of the measurement variables for information integration

Variable	Definition	Sources
Standardization	The common policies and procedure and consistent and common approach to facilitate logistics operation	Frohlich and Westbrook (2001); Stank et al. (2001)
Cross Functional Integration	The competency of linking the integration function internal functions of the performed work into seamless process	Bettman (1975); Stank et al. (2001)

The attributes of the Information Capabilities are measured by two variables which are IT infrastructure, and information sharing. The definition of each variable is presented in table 3.5.

**Table 3.5** Definition of the measurement variables for information capabilities

Variable	Definition	Sources
IT Infrastructure	Firm's overall physical IT assets and sharable platform and databases	G. Ross (1993)
Information Sharing	The willingness to share information on the timely, accurate and responsive basis	Bharadwaj (2000); Wu, Chuang, and Hsu (2014)

The impact of the information integration with information capabilities on Supply Chain Performance is measured by two variables which are reliability and flexibility and responsiveness and productive. The definition of each variable is presented in table 3.6.

**Table 3.6** Definition of the measurement variables for supply chain performance

Variable	Definition	Sources
Reliability	Supply chain reliability is defined as the probability of the chain meeting mission requirements to provide the required supplies to the critical transfer points within the system	Thomas (2002)
Flexibility and Responsiveness	It having a great implementation team, and it have a grate consulting partner from the experience in some of the previous case.	Velcu (2007); (Umble, Haft, & Umble, 2003)

### 3.3.5 Validity and Reliability

The content validity is the evaluation which relies on subject-matter experts who are familiar with the construct being used in the questionnaire to help determine if the research instrument can provide answers to the research questions. The questionnaire will be reviewed and assessed by six subject-matter experts, consists of four university academicians and two professionals from business sector based on IOC (Index of Item-Objective Congruence) method. The results from the evaluation will be used to adjust and improve for the accuracy and validity of the questionnaire.

### 3.4 Qualitative Methodology

Qualitative methodology is a method which provides detailed explanation and descriptions of the procedures, situation, communications, experiences and knowledge related to the questions raised in the study. Qualitative can be defined into three different level of data collection: Individual surveys, Individual Interviews and, and Expert Panel Interview. All of these could provoke deep level of responses in an open-ended environment in the data collection process which allows richness of information (Hopp, 2005).

The individual interviews are considered one among the most powerful means for obtaining crucial research data, and also is an effective tool to learn about expert opinions, and explore reaction on important events. Interviews are challenging and yet rewarding forms of measurement (Hopp, 2005), as they provide detailed explanation and descriptions of the procedures, situation, communications, experiences and knowledge related to the questions raised in the study.

Interviewing requires personal sensitivity and adaptability as well as the ability to stay within the bounds of a series of prearranged queries provided specific subject related data points. This process reduced bias that might be generated by the researcher's influence or as to any indiscrimination

### **3.4.1 Population and Sampling**

This research will be conducted across several organizations in the Thai food processing industry, as to ensure appropriate and accurate results, participants will be equally and randomly selected and strictly on voluntarily basis. The target key participants are logistics managers or directors. Otherwise, the participants will, at least, have to meet the following key criterion:

- 1) Participant is actively engaged in the company's supply chain process and activities.
- 2) Participant is recognized as having adequate knowledge about the company's information integration and information capabilities.
- 3) Participant has been identified as a key member and in the role that are able to share the survey information.

The interview will be conducted with a small group, the initial size of sample is not defined due to the voluntary and availability, the interview will however, be iterated until the answers for the hypotheses are met.

### **3.4.2 Research Instrumentation**

Chava and David (1996) provided that interviewing involves a face-to-face interpersonal situation in which interviewer ask questions of respondents designed to raw answers related to research hypotheses.

This interview utilized a standardized interview questions to obtain critical insight from the selected interviewee. The interviewer utilizes a scripted format to

maintain reliability and consistency with all interviews. This method will enable the interviewer a more control over the environment and the questions. While the questions are open-ended and penetrating, the process is designed to allow flexibility to the interviewee for thought provoking collaboration as needed.

### **3.4.3 Individual Interview Practice**

The individual interview involved a one-to-one meeting in a neutral setting where the interviewer engages in a series of prepared questions that elicited responses that are relevant to the research questions. Questions, words and sequences will determine the structure of the interview. (Chava & David, 1996). The interviews will be conducted to qualitatively measure the logistics capabilities as resources to create competitive advantage and superior performance of the firm.

### **3.4.4 Interview Questions**

1) What are your company supply chain functions, in your opinion do they have the same contribution to the success of the company?

2) What do you consider the specific resources and capabilities of each of your information functions and on what criteria?

3) Can the competitive advantage of the company be developed based on those specific resources and capabilities?

4) In your opinion, does the information sharing of demand and supply environment functions improve the performance of the company?

5) Does your company coordinate well with your supplier?

6) How well do supply chain functions response to the customers' requirement?

7) Do you think that the IT system contributes to the success of the company?

8) Do you think that the information capabilities facilitate other supply chain functions?

9) Does each individual supply chain function influence each other?

10) Does each individual supply chain function coordinate well with each other? If not, what is the problem for not being able to do so?

11) In your opinion, does the information integration of supply chain functions improve the performance of the company?

12) Do you think that the information of ERP system contributes to the success of the company?

### 3.5 Sequence of Analysis

The analysis of the study is presented in the following sequence:

#### 1. Quantitative research

##### 1.1 Survey pretesting

- 1) Content Validity testing
- 2) Reliability testing, 30 tryout sampling
  - Cronbach's alpha testing
- 3) Redesigning of the questionnaire if required  
(in case of Cronbach's alpha less than 0.7)

##### 1.2 Statistics Analysis

- 1) Descriptive Statistic Analysis
  - Mean, Frequency
- 2) Reliability testing
  - Cronbach's alpha testing
- 3) Validity testing
  - Confirm Factor Analysis (Convergent validity)
  - SEM Method (Discriminate validity)
- 4) Structural Equation Modeling
  - 4.1) Development of the model
  - 4.2) Analysis of the model
  - 4.3) Measure of fit
    - Consider  $\chi^2$ ,  $\chi^2/df$ , degree of freedom,  $p$ -value, RMSEA, GFI
    - If the model does not fit, modify the indices and re-analyze the model
  - 4.4) If the model fits
    - Analysis of the regression weight,  $p$ -value
    - Analysis of direct/indirect relationship
- 5) Quantitative research reporting

## 2. Qualitative research

### 1) Individual interview

- Description content analysis
- Propose of the working hypotheses

### 2) Iteration of the interview

- Description content analysis
- Repeat until the working hypotheses are justified

### 3) Qualitative research reporting

## 3. Analysis of both quantitative research and qualitative research

## 4. Conclusion



## **CHAPTER 4**

### **RESEARCH RESULTS**

This chapter presents the empirical findings of the undertaken statistical analysis and hypotheses testing using the data gathered from respondents in Thailand's food processing industry. This chapter is organized into four sections. The first section covers instrument validation, pretesting, and data preparation. The next section presents the demographic summary and descriptive statistics. The following section covers statistical analysis and structural model analysis, while the last section discusses the results of hypothesis testing and the summary.

#### **4.1 Instrument Validation and Pretesting**

The validation of the questionnaire's measurement items' content validity was performed using the Index of Item-Objective Congruence (IOC) (Innis & La Londe, 1994) was a critical developmental stage for instrument validation to ensure each observed variable's validity within the group of constructs. Five experts (two logistics managers and three academic researchers) evaluated the IOC of this study. The overall assessment score was 0.87, which was considered acceptable. Comments and suggestions on the wordings and rewordings, the sequence of questions, and the questions' presentation were received and incorporated into the adjusted data collection questionnaire.

##### **4.1.1 Pretesting for Reliability**

The pretesting was conducted to determine if the questionnaire's items contain ambiguity that might lead to the respondent's misinterpretation of the items' statements. A reliable questionnaire should repeatedly yield the same response from respondents. The assessment of the reliability was done by comparing one respondent's answers with another (Visser, Krosnick, & Lavrakas, 2000). The trial questionnaires were distributed to 30 selected respondents who worked in the food industry's supply chain. Cronbach's alpha was used as a means to assess the internal consistency of how closely the set of items as a group are related and considered a coefficient of reliability. Theoretically, the value of Cronbach's alpha ranges from zero to one; the higher value indicates more

reliability. A value of 0.80 or higher is considered reliable. The Cronbach's alpha coefficient from the pretesting was 0.94, indicating that the items have relatively high internal consistency.

## **4.2 Data Preparation**

### **4.2.1 The Population and Sample Response Rate**

The setting of the population for data collection surveyed was the Thai food processing industry. A total of 1,200 contact information was obtained from the database of the Department of Industrial Works.

In previous studies, mail surveys were found to have a low response rate. Cho, Ozment, and Sink (2008) referred to Anderson and Narus's research in 1990 that received about 10 percent returned mail. The mail response rate could be as low as 4.1 percent, as demonstrated by the study. They suggested that mail-based questionnaires' return rate should not be less than 20 percent to be acceptable. Therefore, to avoid issues with the low response rate, the questionnaires were mailed to industry directors or managers of each company of the 1,200 companies from ten clusters in the food processing industry on a weighted proportional basis. The data were collected through a combination approach. The respondents were provided with options to complete and return the questionnaire through a self-addressed postage-paid return envelope, by fax, or web-based.

While the low response rate might raise concerns on the response bias, there have been no significant differences between the means with *t*-test at  $p < .05$  between early (responded within the first month) and late responses. Therefore, no nonresponse bias is detected in research with low response rates.

A total of 243 questionnaires were received, which accounted for a 20.25 percent response rate. There were nine returned questionnaires with insufficient data, skipping sections, or quitting in the middle. These questionnaires were excluded from statistical analysis. Overall, there were a total of 234 completed questionnaires received from 1,200 questionnaires mailed; thus, the response rate was 19.5 percent.

The characteristics of the returned questionnaire by Food processing industry clusters are shown in table 4.1.



**Table 4.1** Characteristics of the returned questionnaire

Industry clusters	Sample size	Sent by Mail	Returned Questionnaire	Percentage of return
Animal and Processed meat products	215	173	28	16.18
Poultry products	151	123	28	22.76
Fishery and Marine products	220	132	28	21.21
Milk and Dairy products	158	84	10	11.90
Fruits and Vegetable Products	283	145	37	25.52
Fat and Oil products	298	68	5	7.35
Foods products made from flour	241	143	27	18.88
Condiments and Seasoning ingredients	186	112	19	16.96
Beverages and Drinks	284	123	32	26.02
Sugar and Confectionery products	256	97	20	20.62
Total	2,292	1,200	234	19.50%

#### 4.2.2 Data Coding and Entry

The variables in this study have been encoded so as to simplify the data processing and interpretation process. The abbreviations used for variables are shown in Table 4.2.

IBM's statistical software packages were used for data analysis. SPSS Statistics version 20 was used for descriptive statistics, and AMOS version 23 was used for Structural Equation Model (SEM) analysis.

**Table 4.2** Abbreviation of constructs and observed variables

Construct	Observed variables	Type of variable
ERP System (ERP)	Organization2 (ERPOrg2)	Independent
	Organization3 (ERPOrg3)	Variable
Demand and Supply	Delivery (DSEDel)	Independent
Environment (DSE)	Timeliness1 (DESTime1)	Variable
	Timeliness (DESTime2)	
	Customer Responsiveness (DSECus)	
	Customer Information Quality (DSECusInfo)	
	Communication1 (DSEComm1)	
	Relationship1 (DSERela1)	

**Table 4.2** Abbreviation of constructs and observed variables (Cont.)

Construct	Observed variables	Type of variable
Information	Standardization1 (IStd1)	Mediating
Integration (II)	Standardization2 (IStd2)	Variable
	Cross-functional Integration (IICross)	
Information Capabilities (IC)	IT Infrastructure2 (ICInfra2)	Mediating
	Information Sharing2 (ICInfo2)	Variable
Supply Chain Performance (SCP)	Reliability2 (SCPREli2)	Dependent
	Flexibility and Responsiveness1 (SCPFlex1)	Variable

### 4.3 Demographic Summary

The respondents' demographic information was summarized and described in categories, frequencies, and percentages, as shown in Table 4.3.

**Table 4.3** Summary of the demographic

Demographic	Frequency	Respondent percentage
Age		
Less than 31 years old	28	11.52
31-40 years old	109	44.86
41-50 years old	73	30.04
Over 51 years old	24	9.88
Educational qualification		
High School and lower	0	0.00
Vocational/Technical	2	0.85
High Vocational/Technical	18	7.69
Undergraduate	132	56.41
Postgraduate	82	35.04
Other	0	0.00

**Table 4.3** Summary of the demographic (Cont.)

Demographic	Frequency	Respondent percentage
Position and responsibility		
Executives	31	12.76
Departmental manager	92	37.86
Divisional supervisor	81	33.33
Others	30	12.35
Years of working experiences in the logistics functions		
1-5	90	38.46
6-10	28	11.97
11-15	48	20.51
More than 15	68	29.06
Type of Business, Number of employee and Registered Capital (Million Baht)		
Manufacturing Business (Small Enterprise), Number of employees Lower than 50 and Registered Capital Lower than 50 million	38	16.24
Manufacturing Business (Medium Enterprise), Number of employees Lower than 200 million and Registered Capital Lower than 200 million	67	28.63
Manufacturing Business (Large Enterprise), Number of employees Larger than 200 million and Registered Capital Larger than 200 million	56	23.93
Wholesale Business (Small Enterprise), Number of employees Lower than 50 and Registered Capital Lower than 50 million	13	5.56
Wholesale Business (Medium Enterprise), Number of employees Lower than 200 million and Registered Capital Lower than 200 million	-	0.00
Wholesale Business (Large Enterprise), Number of employees Larger than 200 million and Registered Capital Larger than 200 million	-	0.00

**Table 4.3** Summary of the demographic (Cont.)

Demographic	Frequency	Respondent percentage
Retail Business (Small Enterprise), Number of employees Lower than 50 and Registered Capital Lower than 50 million	13	5.56
Retail Business (Medium Enterprise), Number of employees Lower than 200 million and Registered Capital Lower than 200 million	-	0.00
Retail Business (Large Enterprise), Number of employees Larger than 200 million and Registered Capital Larger than 200 million	4	1.71
Service Business (Small Enterprise), Number of employees Lower than 50 and Registered Capital Lower than 50 million	9	3.85
Service Business (Medium Enterprise), Number of employees Lower than 200 million and Registered Capital Lower than 200 million	-	0.00
Service Business (Large Enterprise), Number of employees Larger than 200 million and Registered Capital Larger than 200 million	34	14.53

#### 4.3.1 Profile of the Respondents

The demographic data from respondents were classified into personal profiles and organizational profiles. The personal profiles comprised age group, educational background, job position, and experiences in logistics functions. These profiles were used to determine the qualifications of the key informant (Campbell, 1955). In comparison, the organizational profiles identified the firm's nature of the investment, registered capital, and employees' size. The organizational profiles were used to determine the firms' characteristics.

In terms of age group, the personal profile of respondents showed that the majority of the respondents were within the age group of 31-40 years old, which accounted for 44.86% of the respondents. This was followed by the age group of 41-50 years old at 30.04%, the age group of less than 31 years old at 11.52%, and the age group of over 51 years old at 9.88%. As for the educational background, respondents with undergraduate qualifications were the largest group, which accounted for 56.41%. The respondents with postgraduate qualifications followed at 35.04%. The remaining

respondents had high vocational and technical certificates at 7.69% and vocational and technical certificates at 0.85%. In terms of job position categories, the respondents were mainly departmental managers at 37.86%. Divisional supervisor occupied the second-largest job category at 33.33%. The executive-level positions only accounted for 12.76% of the respondents. The remaining respondents (12.35%) occupied other positions. As for working experiences in the logistics functions, the group with working experiences between 1-5 years was the dominant group at 38.46%. The group with experiences of more than 15 years followed at 29.06%. The remaining groups' respondents had 11-15 years (20.51%) and 6-10 years (11.97%) experiences.

The respondents' organizational background characteristics were determined in three operational factors: the firm size, the number of employees, and the registered capital. With the use of the factors mentioned above, the businesses were categorized into four major types: manufacturing, service, retail, and wholesale. Firstly, the manufacturing business firms (Medium Enterprise) employing lower than 200 million and having registered capitals of lower than 200 million Baht accounted for 28.63% of the respondents. The firms with manufacturing businesses (Large Enterprise) that employed larger than 200 million and reported registered capitals of larger than 200 million Baht followed at 23.93%. The smallest group was the firms with manufacturing businesses (Small Enterprise) at 16.24%. This group employed lower than 50 workers and had registered capitals of Lower than 50 million Baht. Secondly, the service business firms (Large Enterprise) employing larger than 200 million and registering business capitals larger than 200 million Baht accounted for the majority of the respondents at 14.53%. This group was followed by the firms with service businesses (Small Enterprise) that employed lower than 50 workers and registered capitals of lower than 50 million Baht at 3.85%. The group that contained firms with service businesses (Medium Enterprise) that employed lower than 200 million and registered capitals of lower than 200 million did not respond to the survey. Thirdly, the retail business firms (Small Enterprise) with lower than 50 employees and registered capitals lower than 50 million Baht were the majority of the respondents and accounted for 5.56%. This was followed by the firms with retail business (Large Enterprise) that had larger than 200 million employees and registered capitals larger than 200 million Baht at 1.71%. The firms with retail business (Medium

Enterprise) that employed lower than 200 million and registered capitals lower than 200 million Baht did not give responses. Finally, firms with wholesale businesses (Small Enterprise) accounted for 5.56%. These firms employed lower than 50 workers and registered capitals lower than 50 million Baht. The firms with wholesale businesses that belonged to the Medium Enterprise and Large Enterprise categories provided no answers. The characteristics of the majority of the respondents are summarized in Table 4.4 below.

**Table 4.4** Characteristics of the majority of the respondents

Characteristics		Percentage
Personal Profile	Age between 31-40 years old	44.86
	with undergraduate education	56.41
	Job position as Departmental manager	37.86
	1-5 years of working experiences in the logistics functions	38.46
Organizational Profile	Manufacturing Business (Medium Enterprise), Number of employees Less than 200 million and Registered Capital Less than 200 million	28.63

The respondents could be summarized as predominantly aged between 31-40 (44.86%) with undergraduate qualification (56.41%). They had 1- 5 years of working experience (38.46%) and held departmental manager positions (37.86). As for the organizational profile, the majority of responding companies were manufacturing businesses (Medium Enterprise), employing less than 200 million and having registered capital of less than 200 million Baht (28.63%).

#### 4.4 Descriptive Statistics

The following section summarized the features of data collected for the study and presented them quantitatively and comparatively.

##### 4.4.1 ERP System

The attribute of the ERP System construct was measured by one observed variable, which is the organization. These independent variables comprised of two items that were used to rate the respondent's level of agreement. The statistical analysis of the

minimum and maximum score, mean values, and standard deviation values are shown in table 4.5.

**Table 4.5** Descriptive statistics for ERP system.

Variable	Min	Max	Mean	Std.
Organization				
ERPOrg2	1	7	4.91	1.484
ERPOrg3	1	7	5.26	1.344

The item with the highest mean value is “ERPOrg3 (ERP System Organization 3)” (M=5.26, SD=1.344) under the organization variable. The item with the lowest mean value is “ERPOrg2 (ERP System Organization 2)” (M=4.91, SD=1.484) under the organization variable.

#### 4.4.2 Demand and Supply Environment

The attribute of the demand and supply environment construct was measured by six observed variables, which were delivery, timeliness, customer responsiveness, customer information quality, communication, and relationship. These independent variables consisted of two items which were used to rate respondent’s level of agreement. The statistical analysis of the minimum and maximum scores, mean values, and standard deviation values are shown in table 4.6

**Table 4.6** Descriptive statistics for demand and supply environment

Variable	Min	Max	Mean	Std.
Delivery				
DSEDel	4	7	6.19	0.878
Timeliness				
DSETime1	2	7	6.12	1.029
DSETime2	2	7	6.23	0.929
Customer Responsiveness				
DSECus	4	7	6.36	0.780
Customer Information Quality				
DSECusInfo	4	7	6.31	0.775

**Table 4.6** Descriptive statistics for demand and supply environment (Cont.)

Variable	Min	Max	Mean	Std.
Communication				
DSEComm1	2	7	6.03	1.092
Relationship				
DSERela1	3	7	6.40	0.748

The item with the highest mean value is “DSERela1 (demand and supply environment relationship1)” (M=6.40, SD=0.748) under the relationship variable. The item with the lowest mean value is “DSEComm1 (demand and supply environment communication1)” (M=6.03, SD=1.092) under the communication variable.

#### 4.4.3 Information Integration

The information integration construct's attribute was measured by two observed variables: standardization and cross-functional integration. These mediating variables consisted of two items which were used to rate respondent's level of agreement. The statistical analysis of the minimum and maximum score, mean values, and standard deviation values are shown in table 4.7.

**Table 4.7** Descriptive statistics for information integration

Variable	Min	Max	Mean	Std.
Standardization				
IIStd1	1	7	5.50	1.337
IIStd2	1	7	5.23	1.428
Cross-functional Integration				
IICross	1	7	5.33	1.374

The item with the highest mean value is “IIStd1 (information integration standardization1)” (M=5.50, SD=1.337) under the standardization variable. The item with the lowest mean value is “IIStd2 (information integration standardization2)” (M=5.23, SD=1.428) under the standardization variable.

#### 4.4.4 Information Capabilities

The information capabilities construct was measured by two observed variables: IT infrastructure and information sharing. These mediating variables consisted of two



items which were used to rate respondent's level of agreement. The statistical analysis is of the minimum and maximum score, mean values, and standard deviation values, as shown in table 4.8.

**Table 4.8** Descriptive statistics for information capabilities

Variable	Min	Max	Mean	Std.
IT Infrastructure				
ICInfra2	1	7	5.14	1.336
Information Sharing				
ICInfo2	2	7	5.61	1.123

The item with the highest mean value is “ICInfo2 (information capabilities information sharing2) between consumer and supplier” (M=5.61, SD=1.123) under the information sharing variable. The item with the lowest mean value is “ICInfra2 (information capabilities IT Infrastructure2)” (M=5.14, SD=1.336) under the IT infrastructure variable.

#### 4.4.5 Supply Chain Performance

The supply chain performance construct's attribute was measured by two observed variables: reliability and flexibility, and responsiveness. These dependent variables consist of two items that were used to rate the respondent's level of agreement. The statistical analysis of the minimum and maximum score, mean values, and standard deviation values are shown in table 4.9.

**Table 4.9** Descriptive statistics for supply chain performance

Variable	Min	Max	Mean	Std.
Reliability				
SCPReli2	2	7	5.59	1.029
Flexibility and Responsiveness				
SCPFlex1	2	7	5.67	1.040

The item with the highest mean value is “SCPFlex1 (supply chain performance flexibility and responsiveness1)” (M=5.67, SD=1.040) under flexibility and

responsiveness variables. The item with the lowest mean value is “SCPReli2 (supply chain performance reliability2)” (M=5.59, SD=1.029) under the reliability variable.

#### **4.5 Normality Testing**

A normality test is used to determine whether the data set is normally distributed. A good questionnaire design should yield normal distribution of the data. Statistically, two common indicators which are referred to for normal distribution assessment are skewness and kurtosis. Skewness is a measure of symmetry, whereby the skewness value of zero suggests symmetry or normality of the distribution of the data set. Kurtosis is a measure of combined sizes of the two tails; the kurtosis value for a normal distribution is equal to three. However, it is often reported in the form of “excess kurtosis” by subtracting three from the normal value; therefore, the kurtosis value is equal to zero. DeCarlo (1997) proposed that skewness should be between -1 and +1 to judge with a normal distribution. Serulle et al. (2015) proposed that the value of kurtosis between -2 and +2 is considered acceptable in order to prove normal univariate distribution.

The data for this study are well within a normal distribution. The results of the data set from this study indicate the value of skewness ranging from -0.85 to -0.31, with a standard error of skewness at 0.152. The value of kurtosis ranges from -0.43 to 1.01, with a standard error of kurtosis at 0.303; in both cases, all the values fall within the limit, which indicate the normal distribution of the data.

#### **4.6 Structural Equation Model**

The reliability was assessed by determining the Cronbach’s alpha coefficient, where the model fit was evaluated through Confirmatory Factor Analysis (CFA) through the AMOS statistical software. AMOS is a graphical extension module of the SPSS program and has been widely used for Structural Equation Modeling (SEM), path analysis, and confirmatory factor analysis. The software provides visual and graphical features for model drawing and analyzing with quick computation for SEM analysis. The CFA analysis through AMOS software allow the adjustment of the model until the model becomes acceptable.

#### 4.6.1 Reliability Analysis

The reliability of the variables used in the model was assessed through the analysis of Cronbach's alpha. Cronbach's alpha measures the internal consistency and analyzes whether a set of items used in the model is related to each other. The theoretical value of the alpha ranges from zero to one, of which the higher value indicates better survey quality; hence more reliable. It is suggested that Cronbach's alpha coefficient of 0.7 or higher is considered acceptable. The results of Cronbach's alpha coefficient analysis of the current study are shown in table 4.10.

**Table 4.10** Results of Cronbach's alpha coefficient analysis

Latent Variables	Observe Variables	Cronbach's Alpha Coefficient	Mean	SD
ERP	ERPOrg2	0.896	4.91	1.484
	ERPOrg3	0.898	5.26	1.344
DSE	DSEDel1	0.899	6.19	0.878
	DSETime1	0.898	6.12	1.029
	DSETime2	0.898	6.23	0.929
	DSECus	0.899	6.36	0.780
	DSECusInfo	0.899	6.31	0.775
	DSEComm1	0.899	6.03	1.092
	DSERela1	0.898	6.40	0.748
II	IIStd1	0.894	5.50	1.337
	IIStd2	0.894	5.23	1.428
	IICross	0.894	5.33	1.374
IC	ICInfra2	0.894	5.14	1.336
	ICInfo2	0.896	5.61	1.123
SCP	SCPReli2	0.895	5.59	1.029
	SCPFlex1	0.896	5.67	1.040

The Cronbach's alpha coefficient results for all the items used in the model range from 0.894 to 0.899. The mean values range from 4.91 to 6.40, and the standard deviation range from 0.748 to 1.484.

The ERP system is consisting of three items. The Cronbach's alpha coefficient of the items was 0.897, the mean values range from 4.91 to 5.26, and the standard deviations ranged from 1.344 to 1.484. The alpha supported this construct's reliability and indicated the acceptability of the ERP system's measurement in the model.

The demand and supply environment construct consists of nine items in which the overall Cronbach's alpha coefficient is 0.898, the mean values range from 6.03 to 6.40, and the standard deviations range from 0.748 to 1.092. The alpha figure confirms this construct's reliability and indicates its acceptability for measuring the demand and supply environment in the model.

The information integration construct consists of three items. The Cronbach's alpha coefficient of the items is 0.894, the mean values range from 5.23 to 5.50, and the standard deviations range from 1.337 to 1.428. The reliability alpha confirms the construct's acceptability for the measurement of the information integration in the model.

The information capabilities construct consists of four items. The items' Cronbach's alpha coefficient is 0.895, which confirms the reliability of this construct and its acceptability for measuring the information capabilities in the model. The mean values range from 5.14 to 5.61, and the standard deviation range from 1.123 to 1.336.

The Supply chain performance construct consist of four items found to have a Cronbach's alpha coefficient of 0.896. The mean values range from 5.59 to 5.67, and the standard deviations range from 1.029 to 1.040. The alpha coefficient confirms that this construct's reliability is acceptable for the measurement of the supply chain performance in the model.

The total reliability statistics is 0.897 for 16 items. The Cronbach's alpha coefficients are well above 0.7, indicated reliability and acceptability for the analysis.

#### **4.6.2 Multicollinearity Testing**

The testing of multi-collinearity is an analysis of the non-relationship between variables. The tolerance must be more than 0.1, and the Variance Instruction Factor (VIF) value must be lower than 10. The analyzed tolerance values range from 0.202 - 0.512, and VIF values range from 1.954 - 4.950, indicating no multi-collinearity among variables. The analyzed values are shown in Table 4.11.

**Table 4.11** Multicollinearity testing results

Latent Variables	Observe Variables	Collinearity Statistics	
		Tolerance	VIF
ERP	ERPOrg2	.480	2.081
	ERPOrg3	.469	2.131
DSE	DSEDel1	.512	1.954
	DSETime1	.413	2.419
	DSETime2	.333	3.004
	DSECus	.335	2.989
	DSECusInfo	.399	2.507
	DSEComm1	.352	2.843
	DSERela1	.424	2.358
	II	IIStd1	.208
	IIStd2	.294	3.407
	IICross	.221	4.518
IC	ICInfra2	.294	3.398
	ICInfo2	.362	2.763
SCP	SCPReli2	.383	2.611
	SCPFlex1	.460	2.174

### 4.6.3 Construct Validity

The construct validity is the evaluation of the degree to which the test is actually measuring the theoretical construct it claims and attempts to measure. The construct validity is divided into two subcategories; convergent validity testing and discriminant validity testing. The convergent validity is the test of whether constructs that are expected to be related are in fact related to the others. Discriminant validity is the test of whether constructs that should have no relationship are, in fact, do not have a relationship.

The convergent validity assessed the extent that the indicators could represent the construct. In other words, convergent validity examines the degree to which the measurement is similar to other measurements. In this study, convergent validity has been evaluated through factor loadings. The factor loadings of all items are ideally be exceeding 0.6; however, the minimum acceptable level is 0.4.

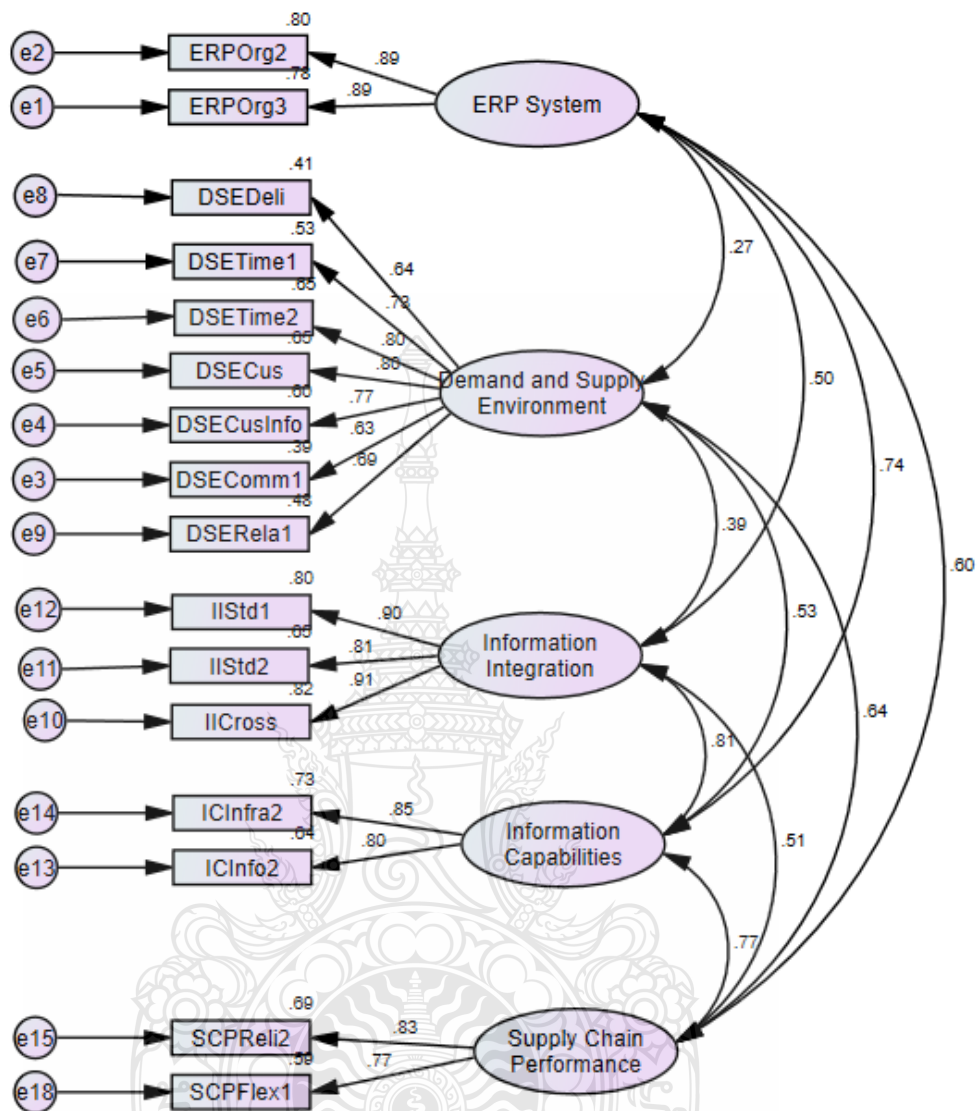
Confirmatory Factor Analysis (CFA) is used to evaluate the relationship between variables with the priority in evaluating the relationship pattern of the model

variables. CFA is an evaluation of whether the set of variables are good representatives for the construct (Chong, Nazim, & Ahmad, 2014). The assessment indicators include  $p$ -value (Chi-square Probability Level), CMIN/df (Relative Chi-square), GFI (Goodness of Fit Index), AGFI (Adjusted Goodness of Fit), RMSEA (Root Mean Square Error of Approximation), and NFI (Normed Fit Index). The  $p$ -value should be significantly associated with each loading. The CMIN/df value should be less than 3. GFI, TLI, and NFI values should be higher than 0.90, and AGFI should be higher than 0.80. RMSEA should be lower than 0.08. If the above criteria are met, the CFA would consider the data-fit of the model.

Convergent validity can be evaluated using the average variance extracted (AVE). The model would be acceptable if the AVE is equal to or higher than 0.5 (Fornell & Larcker, 1981). The AVE is calculated based on the calculation formula as follows:

$$AVE = \frac{\sum_{i=0}^n Li^2}{n} > 0.5$$

The evaluation of convergent validity is done through CFA. The observed variable can be considered a good representative of the construct if the factor loading value is higher than 0.6. Further, all average variance extracted (AVE) of all variables should not be higher than 0.5, and the composite reliability (CR) of all variables should be higher than 0.6.



**Figure 4.1** Measurement model (standardization)

The summary of items used after the CFA testing found the convergent and discriminant validity. The hypothesized model analysis for decision to kept 16 items as figure 4.1. Thus, some items decision to dropped because the evaluation of convergent validity is done through CFA. The observed variable can be considered a good representative of the construct if the factor loading value is higher than 0.6. moreover, all average variance extracted (AVE) of all variables should not be higher than 0.5, and the composite reliability (CR) of all variables should be higher than 0.6.

#### 4.6.4 Convergence Validity Testing

The table 4.12 – 4.16 indicated the assessment of convergent validity.

**Table 4.12** Factor loading,  $R^2$ , Composite Reliability (CR), and Average Variance Extracted (AVE) of variables (ERP System)

Variables	Factor loading	$R^2$	Composite Reliability	AVE
ERP System			0.883	0.790
ERPOrg2	0.893	0.797		
ERPOrg3	0.885	0.783		

The ERP system construct's factor loading values range from 0.885 to 0.893, which are all higher than 0.6. The  $R^2$  values range between 0.783 to 0.797, which are within the acceptable range. The composite reliability is 0.883, indicating the acceptability of construct reliability. The acceptable AVE value must be higher than 0.5 (Fornell & Larcker, 1981), and the AVE of the construct is 0.790, also confirming the acceptability of the construct reliability.

**Table 4.13** Factor loading,  $R^2$ , Composite Reliability (CR), and Average Variance Extracted (AVE) of variables (DSE)

Variables	Factor loading	$R^2$	Composite Reliability	AVE
DSE			0.886	0.529
DSEDel1	0.641	0.589		
DSETime1	0.728	0.470		
DSETime2	0.803	0.355		
DSECus	0.804	0.354		
DSECusInfo	0.773	0.402		
DSEComm1	0.627	0.607		
DSERela1	0.692	0.521		

The DSE construct items show factor loading values that range from 0.627 to 0.804, all higher than 0.6. The  $R^2$  values range between 0.354 to 0.607, which are within the acceptable range. Composite reliability is at 0.886, indicating the acceptability of



construct reliability. The AVE of the construct in the model is 0.529, which also indicates the construct reliability's acceptability.

**Table 4.14** Factor loading,  $R^2$ , Composite Reliability, Average Variance Extracted of Mediating variable (II)

Variables	Factor loading	$R^2$	Composite Reliability	AVE
II			0.903	0.758
IStd1	0.896	0.803		
IStd2	0.806	0.650		
ICross	0.906	0.821		

The items for the II construct have factor loading values ranging from 0.806 to 0.906. The  $R^2$  values range between 0.650 to 0.821, which are within the acceptable range. The composite reliability is at 0.903, indicating the acceptability of construct reliability. The AVE is 0.758, also showing the acceptability of the construct reliability.

**Table 4.15** Factor loading,  $R^2$ , Composite Reliability, Average Variance Extracted of Mediating variable (IC)

Variables	Factor loading	$R^2$	Composite Reliability	AVE
IC			0.814	0.686
ICInfra2	0.854	0.729		
ICInfo2	0.802	0.643		

The IC construct items have factor loading values ranging from 0.802 to 0.854. The  $R^2$  values range between 0.643 to 0.729, within the acceptable range. Composite reliability at 0.814 indicates the acceptability of construct reliability. The AVE is 0.686, which also attests to the acceptability of the construct reliability.

**Table 4.16** Factor loading,  $R^2$ , Composite Reliability, Average Variance Extracted of  
Dependent variable (SCP)

Variables	Factor loading	$R^2$	Composite Reliability	AVE
SCP			0.780	0.639
SCPReli2	0.831	0.697		
SCPFlex1	0.767	0.588		

The SCP construct's measurement items show factor loading values that range from 0.767 to 0.831, which are all higher than the 0.60 minimum requirement. The  $R^2$  values range between 0.697 to 0.588, which are within the acceptable range. The composite reliability at 0.780, indicating the acceptability of construct reliability. The AVE is 0.639, which also indicates the acceptability of the construct reliability.

#### 4.6.5 Discriminant Validity Testing

The discriminant validity test shows that the squared correlation values range from 0.529 to 0.790. These figures support validity since the conventional requirement is  $\geq 0.2$  but not over 1.00. The discriminant validity could also be checked by comparing the AVE value and the squared correlation. Through the AVE evaluation, the instrument's discriminant validity should be more than the squared correlation as recommended by Fornell and Larcker (1981).

$$\text{AVE} > \text{correlation}^2$$

Discriminant validity testing is an evaluation to confirm that the observed variable represents the same latent variable and is not associated with other observed variables of the other latent variables. It provided evidence that the construct is unique and captured some phenomena that are not similar to other constructs (Fornell & Larcker, 1981). This study has verified the instrument's discriminant validity based on the results that followed the required criteria.

The testing results showed that the values supported the discriminant validity, as shown in table 4.17. The value of AVE for each construct is greater than the level of squared correlation involving the construct.

**Table 4.17** Squared correlation between variables

	ERP	DSE	II	IC	SCP
ERP	<b>0.758</b>				
DSE	0.073	<b>0.529</b>			
II	0.250	0.152	<b>0.758</b>		
IC	0.545	0.280	0.656	<b>0.686</b>	
SCP	0.360	0.410	0.260	0.593	<b>0.639</b>

AVE in diagonal

#### **4.7 Structural Model Analysis (SEM) of the Proposed Model**

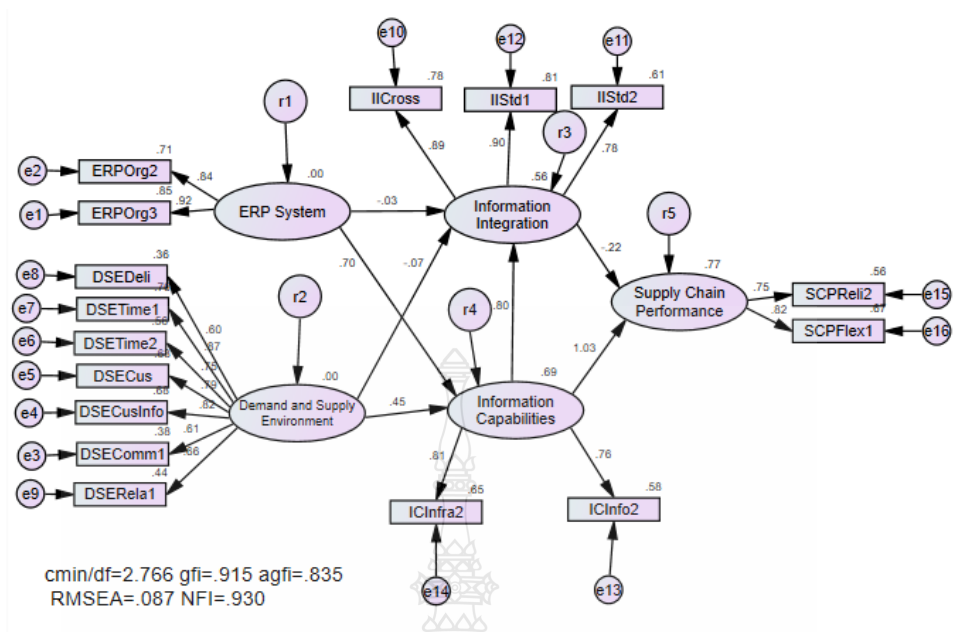
This section presents the analysis of the proposed model through SEM analysis in order to test the hypotheses and identify the answers to the research questions set forth.

A goodness-of-fit test will need to be carried out to measure how well the observed data correspond to the proposed model. The goodness-of-fit test is used to compare the observed values with the predicted values.

For this study, two structural models have been proposed. Structural model one aims to evaluate the direct effects of the constructs and variables. Structural model two seeks to evaluate the direct and indirect effects of the constructs and variables through the mediating variables.

##### **4.7.1 The structural equation model 1.1:**

The structural equation 1.1 aims to examine the relationship between ERP system, demand and supply environment, information integrities, information capabilities, and supply management performance, as shown in Figure 4.2.



**Figure 4.2** The structural equation model 1.1

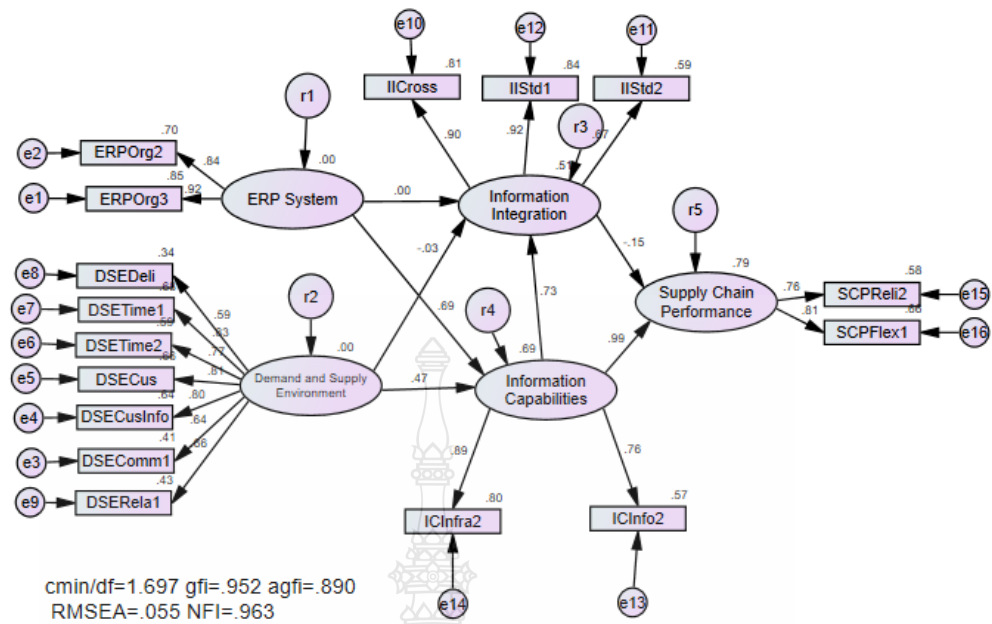
The structural equation model 1.1 aims to investigate the direct effects of ERP system, demand and supply environment, information integrities, and information capabilities on supply management performance.

The goodness-of-fit is conducted. The results of the assessment are as follows: Chi-Square = 193.608; df =70; Chi-Square/Degree of freedom = 2.766;  $p$ -value = .000; GFI = 0.915; AGFI = 0.835; RMR = 0.127; RMSEA = 0.087 (PCLOSE = 0.000); NFI = 0.930; CFI = 0.953; and Hoelter's value = 121 (0.01). The summary and the comparison with the acceptable level for each value are shown in table 4.18.

**Table 4.18** Model fit analysis of the structural equation 1.1

Model Fit Criteria	Value	Acceptable level
Chi-Square	193.608	-
Degree of freedom	70	-
Chi-Square/ df	2.766	$\leq 2$
<i>p</i> -value	0.000	$p > 0.05$
GFI	0.915	$\geq 0.90$
AGFI	0.835	$\geq 0.80$
RMR	0.127	close to zero
RMSEA	0.087	$< 0.10$
NFI	0.930	$> 0.90$
CFI	0.953	$> 0.90$

The initial results suggested that the model did not meet the criteria of model fit as some of the indicators were still unfavorable to the acceptable level. The Chi-Square/Degree of freedom was 2.766. The acceptable level is  $\leq 2$ . The model was adjusted using modification indices: the covariance between residual errors e8 and r1, e2 and r2, e7 and r1, e11 and r1, e5 and e4, e2 and e15, e9 and r4, e8 and e14, e3 and e6, e8 and e10 have been added. The results after modification show an improved model fit with all the indicators values within the acceptable level. The indicators values are Chi-Square = 101.835, df = 60, Chi-Square/Degree of freedom = 1.697, *p*-value = .001, GFI = 0.952, AGFI = 0.890, RMR = 0.074 RMSEA = 0.055 (PCLOSE = 0.319), NFI = 0.963, CFI = 0.984, and Hoelter's value = 203 (0.01). The summary and the comparison with the acceptable level for each value are shown in in table 4.19.



**Figure 4.3** The structural equation model 1.2 (with modification indices)

**Table 4.19** Model fit analysis of the structural equation 1.2 (with modification indices)

Model Fit Criteria	Value	Acceptable level
Chi-Square	101.835	-
Degree of freedom	60	-
Chi-Square/ df	1.697	≤ 2
p-value	0.001	$p > 0.05$
GFI	0.952	≥ 0.90
AGFI	0.890	≥ 0.80
RMR	0.074	Close to zero
RMSEA	0.055	< 0.10
NFI	0.963	> 0.90
CFI	0.984	> 0.90
Hoelter	203	> 200

The analysis of the structural equation 1.2 indicates that there is no direct relationship between ERP System and II (Information Integration), DSE (Demand and Supply Environment), and II (Information Integration). Moreover, II (Information Integration) and SCP (Supply Chain Performance) due to the low estimate value and there

is no statistical significance between the two constructs ( $\beta = -0.002, p>0.05$ ), ( $\beta = -0.030, p>0.05$ ) and ( $\beta = -0.151, p>0.05$ ).

This also indicates that ERP System highly affects IC (Integration Capabilities), and DSE (Demand and Supply Environment) highly affects IC (Integration Capabilities) due to the positive relationship at  $\beta = 0.686 (p<0.001)$  and  $\beta = 0.469 (p<0.001)$ , furthermore, IC (Integration Capabilities) highly affects II (Information Integration) and SCP (Supply Chain Performance) due to the positive relationship at  $\beta = 0.730 (p<0.001)$  and  $\beta = 0.989 (p<0.001)$  respectively.

**Table 4.20** Hypothesis testing for the structural equation 1.2.

			Estimate	S.E.	C.R.	p-value
H1: ERP System	→	II	-0.002	0.091	-0.022	0.982
H2: ERP System	→	IC	0.686	0.044	10.571	***
H3: DSE	→	II	-0.030	0.138	-0.429	0.668
H4: DSE	→	IC	0.469	0.084	7.521	***
H5: IC	→	II	0.730	0.160	6.809	***
H6: IC	→	SCP	0.989	0.112	7.928	***
H7: II	→	SCP	-0.151	0.060	-1.514	0.130

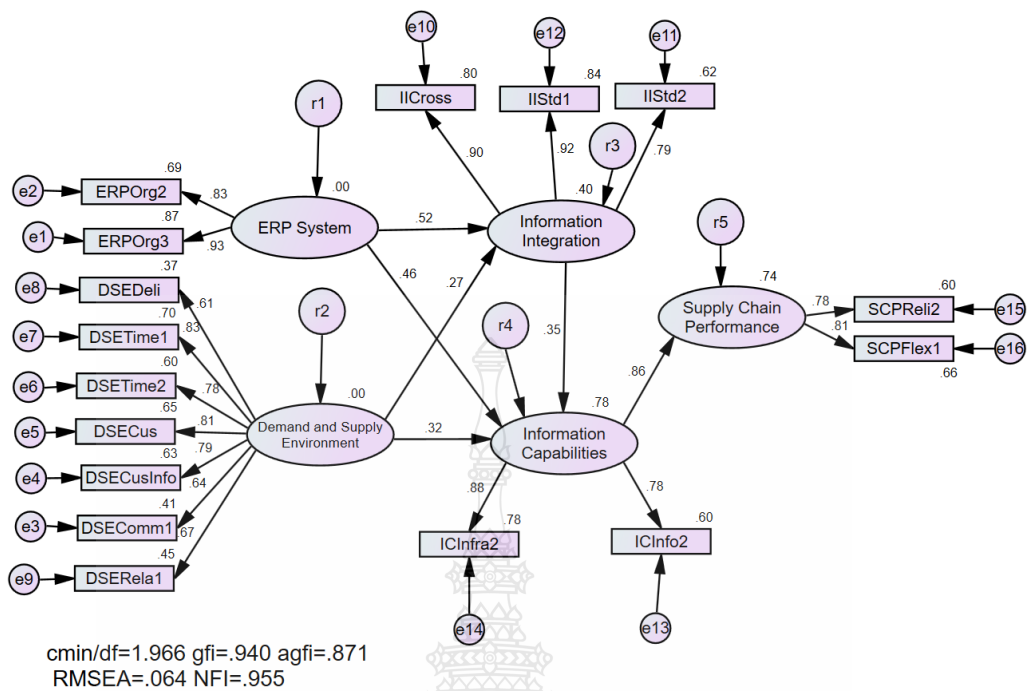
\*\*\* $p$ -value < 0.001 (statistical significance at 0.001 level)

\*\*  $p$ -value < 0.01 (statistical significance at 0.01 level)

\*  $p$ -value < 0.05 (statistical significance at 0.05 level)

#### 4.7.2 The structural equation model 2:

The structural equation model 2 aims to examine the relationship between ERP System, demand and supply environment, information integrities, and supply management performance through integration capability as the mediator, as shown in figure 4.4.



**Figure 4.4** The structural equation model 2.

The structural equation model 2 aims to investigate the direct effects of ERP system and demand and supply environment on information integration and information capabilities; the effect of information integration on information capability; and the effect of integration capability on supply management performance. It also aims to assess the indirect impacts of ERP system, demand and supply environment, and information integration on supply management performance through integration capability as the mediator.

The goodness of fit for the model is assessed, and the results are as follows: Chi-Square = 123.833; df = 63; Chi-Square/Degree of freedom = 1.966; p-value = .000; GFI = 0.940; AGFI = 0.871; RMR = 0.074; RMSEA = 0.064 (PCLOSE = 0.079); NFI = 0.955; CFI = 0.977; and Hoelter's value = 174 (0.01). The summary and the comparison with the acceptable level for each value are shown in Table 4.22.



**Table 4.21** Model fit analysis for the structural equation model 2.

Model Fit Criteria	Value	Acceptable level
Chi-Square	123.833	-
Degree of freedom	63	-
Chi-Square/df	1.966	$\leq 2$
<i>p</i> -value	0.000	$p > 0.05$
GFI	0.940	$\geq 0.90$
AGFI	0.871	$\geq 0.80$
RMR	0.074	close to zero
RMSEA	0.064	$< 0.10$
NFI	0.955	$> 0.90$
CFI	0.977	$> 0.90$
Hoelter	174	$> 200$

The results suggest that the model meets the criteria of the model all fit. The indicators are at an acceptable level.

The analysis of the structural equation model 2 indicates that there is a relationship between ERP system, which are II and IC. The results show that there is a direct relationship between ERP System and II at  $\beta = 0.0517$  ( $p < 0.001$ ) and a direct relationship between ERP System and IC at  $\beta = 0.463$  ( $p < 0.001$ ). These results suggest that ERP system affects II and IC positively. The results also show that there is a direct relationship between DSE and II at  $\beta = 0.273$  ( $p < 0.001$ ) and a direct relationship between DSE and IC at  $\beta = 0.320$  ( $p < 0.001$ ). These suggest that DSE affects both II and IC. Furthermore, for the relationship between II and IC, the results show that there is a direct relationship between them ( $\beta = 0.353$ ;  $p < 0.001$ ). Lastly, the results provides empirical evidence that there is a direct relationship between IC and SCP at  $\beta = 0.857$  ( $p < 0.001$ ).

**Table 4.22** Hypothesis testing for the structural equation model 2.

			Estimate	S.E.	C.R.	<i>p</i> -value
H1: ERP System	→	II	0.517	0.056	9.434	***
H2: ERP System	→	IC	0.463	0.041	8.034	***
H3: DSE	→	II	0.273	0.121	4.633	***
H4: DSE	→	IC	0.320	0.073	6.265	***
H8: II	→	IC	0.353	0.039	6.402	***
H7: IC	→	SCP	0.857	0.069	11.122	***

\*\*\**p*-value < 0.001 (statistical significance at 0.001 level)

\*\* *p*-value < 0.01 (statistical significance at 0.01 level)

\* *p*-value < 0.05 (statistical significance at 0.05 level)

#### 4.8 Summary of Structural Equation Model Analysis

The two structural models are constructed to compare the mediator's mediating effect. The mediators for this study are IC and II.

Ideally, the path coefficient gets smaller with the mediator being added into the model. The comparison of the path coefficients between the two models shows that the path coefficient between ERP System and II in model one is -0.002 ( $p > 0.05$ ), and the path coefficient decreases to 0.517 ( $p > 0.001$ ). The path coefficient between DSE and II in model 1.2 is -0.030 ( $p > 0.05$ ). The path coefficient decreases to 0.273 ( $p > 0.001$ ) in the mediator's presence in model 2. Correspondingly, the path coefficient for ERP System and IC decreases from 0.686 ( $p < 0.001$ ) to 0.331 ( $p > 0.001$ ). Likewise, the path coefficient of DSE to IC reduces from 0.468 ( $p < 0.001$ ) to 0.320 ( $p > 0.001$ ), and the path coefficient of II to IC lowers from 0.730 ( $p < 0.001$ ) to 0.247 ( $p < 0.001$ ). Lastly, the path coefficient from IC to SCP becomes smaller from 0.989 ( $p < 0.001$ ) to 0.857 ( $p < 0.001$ ).

Furthermore, Preacher and Hayes (2008) suggested that mediating effect occurs in the model if the indirect path is statistically significant. The results show that Model 2 indirect paths are statistically significant, indicating that mediating effect has occurred in the model. The indirect path from ERP System to SCP is statistically significant ( $\beta = 1.320$ ;  $p < 0.001$ ), while path coefficients from DSE to SCP ( $\beta = 1.309$ ;  $p < 0.001$ ) and from II to SCP ( $\beta = 1.210$ ;  $p < 0.05$ ) are also significant.

The comparison of the path coefficients between Model 1.2 with Model 2 are presented in Table 4.24.

**Table 4.23** Comparison of the path coefficients between model 1.2 and model 2

				Model 1.2 ( $\beta$ )	Model 2 ( $\beta$ )	
ERP System	→	II		-0.002	0.517***	
ERP System	→	IC		0.686***	0.463***	
DSE	→	II		-0.030	0.273***	
DSE	→	IC		0.468***	0.320***	
IC	→	II		0.730***	-	
II	→	IC		-	0.353***	
IC	→	SCP		0.989***	0.857***	
ERP	→	IC	→	SCP	-	1.320***
DSE	→	IC	→	SCP	-	1.309***
II	→	IC	→	SCP	-	1.210***

\*\*\* $p$ -value < 0.001 (statistical significance at 0.001 level)

\*\*  $p$ -value < 0.01 (statistical significance at 0.01 level)

\*  $p$ -value < 0.05 (statistical significance at 0.05 level)

The standardized direct, indirect and total effect coefficients, and the  $R^2$  results of the SEM analysis are shown in Table 4.24.

**Table 4.24** Standardized Direct, Indirect and Total Effects among variables of Model 2

	$R^2$	Standardized Direct Effect				Standardized Indirect Effect				Standardized Total Effects			
		ERP	DSE	II	IC	ERP	DSE	II	IC	ERP	DSE	II	IC
ERP	.00												
DSE	.00												
II	.40	.517	.273							.517	.273		
IC	.78	.463	.320	.353	.182	.096				.646	.417	.535	
SCP	.74	.000	.000	.000	.857	.553	.357	.302	.000	.553	.357	.302	.857

The structural model exhibits reasonable predictive ability. It explains 40 percent of the variance in II, 78 percent of the variance in IC, and 74 percent of the variance in SCP.

#### 4.9 Model Cross Validation

The K-fold 80/20 observation splitting method was used to measure and confirm the validity of this research model.

1) Start, the original data observation was boot up the data observation from 235 to 500 by using the bootstrapping methods.

2) Randomly divide the whole data observation into five equal observation parts.

3) Use four parts of the data as training data and the other one part as a cross validation data.

4) Alternate some part of training data to act as the cross-validation data which will be acted as the training data instead, while the prior cross validation data part will be acted as the training data part. Iteratively perform this process until the five cycles are completed.

5) The model parameters from five cross validation test are calculated for their average value.

6) Summarize the results of the comparison with the model developed through the research.

The result from the validation result is shown in Table 4.25.

**Table 4.25** Model validation using the K-fold 80/20 split method

Hypothesis	Model2	Training	R1		R2		R3		R4	
			Validate	Training	Validate	Training	Validate	Training	Validate	Training
H1: ERP System → II	.517***	.335***	.427***	.314***	.483***	.399***	.204**	.351***	.345***	
H2: ERP System → IC	.463***	.548***	.473***	.527***	.562***	.489***	.645***	.545***	.492***	
H3: DSE → II	.273***	.411***	.362***	.441***	.217**	.361***	.522***	.359***	.489***	
H4: DSE → IC	.320***	.239***	.249***	.269***	.193**	.253***	.291***	.252***	.239**	
H8: II → IC	.353***	.348***	.470***	.378***	.329***	.395***	.284***	.375***	.373***	
H7: IC → SCP	.857***	.750***	.990***	.832***	.662***	.801***	.777***	.802***	.805***	

After examining the model validation using the K-fold 80/20 Split Method, it was discovered that the model retained its level of statistical significance when compared to the hypotheses, as shown in Table 4.26. As a result, it can be concluded that the model is trustworthy

#### **4.10 Hypothesis Testing**

The following research questions are raised in the earlier discussion:

- 1) Do ERP system, demand and supply environment, information integration, and information capabilities relate to each other?
- 2) Do integration capabilities mediate the relationships between supply chain performance and its antecedents?

Therefore, the following hypotheses have been proposed:

H1: There is a positive relationship between ERP system and information integration.

H2: There is a positive relationship between ERP system and information capabilities.

H3: There is a positive relationship between demand and supply environment and information integration.

H4: There is a positive relationship between demand and supply environment and information capabilities.

H5: There is a positive relationship between information capabilities and information integration.

H6: There is a positive relationship between information integration and supply chain performance.

H7: There is a positive relationship between information capabilities and supply chain performance.

H8: There is a positive relationship between information integration and information capabilities.

##### **4.10.1 Hypothesis H1 Testing**

H1: There is a positive relationship between ERP system and information integration.

The analysis of the relationship between ERP system and information integration (II) indicated a positive relationship between ERP system and II. The results suggest that the path coefficient between ERP system and II is 0.517[standard error (S.E.) = 0.056; critical ratio (C.R.) =9.434;  $p < 0.001$ ].

The factor loading values for each item of the observed variables, ERPOrg2 (ERP System Organization2) and ERPOrg3 (ERP System Organization3), are 0.893 and 0.885, respectively. It was found that the  $p$ -value is lesser than 0.001, suggesting that the result does have a statistical significance which indicates that hypothesis H2 is supported.

Considering the observed variables used for ERP system construct, which are ERPOrg2 and ERPOrg3, all these aspects may directly influence the performance of the food processing companies in Thailand

#### **4.10.2 Hypothesis H2 Testing**

H2: There is a positive relationship between ERP system and information capabilities.

The analysis of the relationship between the ERP system and information capabilities (IC) indicated a positive relationship between ERP system and IC. The results suggested that the path coefficient between ERP system and IC is 0.463, while standard error (SE) is 0.041, critical ratio (CR) is 8.034, and the  $p$ -value is higher than 0.001. The factor loading values for each item of the observed variables, ERPOrg2 (ERP System Organization2) and ERPOrg3 (ERP System Organization3), are 0.893 and 0.885, respectively. It was found that the  $p$ -value, which aims to measure the evidence against the null hypothesis, indicated stronger evidence against the null. The  $p$ -value for this relationship was smaller than 0.001, which suggests that the result does have a statistical significance and indicates that hypothesis H1 is supported.

Considering the observed variables used for ERP system construct, which are ERPOrg2 and ERPOrg3, all these aspects may directly influence the performance of the food processing companies in Thailand.

#### **4.10.3 Hypothesis H3 Testing**

H3: There is a positive relationship between demand and supply environment and information integration.

The analysis of whether the demand and supply environment (DSE) has a positive relationship with information integration (II) indicates a positive relationship between DSE and II. The results show that the path coefficient between DSE and II is 0.273 (S.E. = 0.121; C.R. = 4.633;  $p < 0.001$ ). The factor loading values for each item of the observed variables DSEDel, DSETime1, DSETime2, DSECus, DSECusInfo, DSEComm1, and DSERela1 are 0.641, 0.728, 0.803, 0.804, 0.773, 0.627, and 0.692 respectively. These values indicate a significant positive relationship between demand and supply environment (DSE) and information capabilities (II), and therefore, hypothesis H4 is supported.

The observed variables used for the DSE construct are delivery, timeliness, customer responsiveness, customer information quality, communication, and relationship. Thus, the effective use of information, directly and indirectly, affects firm performance and increases competitive advantage.

#### **4.10.4 Hypothesis H4 Testing**

H4: There is a positive relationship between demand and supply environment and information capabilities.

The relationship between demand and supply environment (DSE) and information capabilities (IC) indicated a positive relationship between DSE and IC. The results show that the path coefficient between DSE and IC is 0.320 (S.E. = 0.073; C.R. = 6.265;  $p < 0.001$ ).

The factor loading values for each item of the observed variables are DSEDel, DSETime1, DSETime2, DSECus, DSECusInfo, DSEComm1, and DSERela1 are 0.641, 0.728, 0.803, 0.804, 0.773, 0.627, and 0.692, respectively. These values indicate a significant positive relationship between demand and supply environment (DSE) and information capabilities (II), and therefore, hypothesis H3 is supported.

The observed variables used for the DSE construct are delivery, timeliness, customer responsiveness, customer information quality, communication, and relationship. Thus, the effective use of information, directly and indirectly, affects firm performance and increases competitive advantage.

#### **4.10.5 Hypothesis H5 Testing**

H5: There is a positive relationship between information capabilities and information integration of the food processing companies in Thailand

The analysis of the relationship between information capabilities (IC) and information integration (II) indicates that there is no positive relationship between them. The results suggested that the path coefficient between IC and II bears no relationship. Thus, hypothesis H5 is not supported.

#### **4.10.6 Hypothesis H6 Testing**

H6: There is a positive relationship between information integration and supply chain performance.

The analysis of the relationship between information integration (II) and supply chain performance (SCP) indicates that there is no positive relationship between the variables. The results confirm II does not positively affect SCP. These, therefore, suggest that hypothesis H6 is not supported.

#### **4.10.7 Hypothesis H7 Testing**

H7: There is a positive relationship between information capabilities and supply chain performance.

The path between information capabilities (IC) and supply chain performance (SCP) indicates a positive relationship. The results show that the path coefficient between IC and SCP is 0.0857 (S.E. = 0.069; C.R. = 11.122;  $p < 0.001$ ). The path coefficient and the  $p$ -value indicate a significantly positive relationship. These figures support hypothesis.

#### **4.10.8 Hypothesis H8 Testing**

H8: There is a positive relationship between information integration and information capabilities.

The analysis of the relationship between information integration (II) and information capabilities (IC) indicates a positive relationship. The results reveal that the path coefficient between II and IC is 0.353 (S.E. = 0.039; C.R. = 6.402;  $p < 0.001$ ). The factor loading values for each item of the observed variables are standardization, and cross-functional integration at 0.896, and 0.906 respectively. These values indicate a

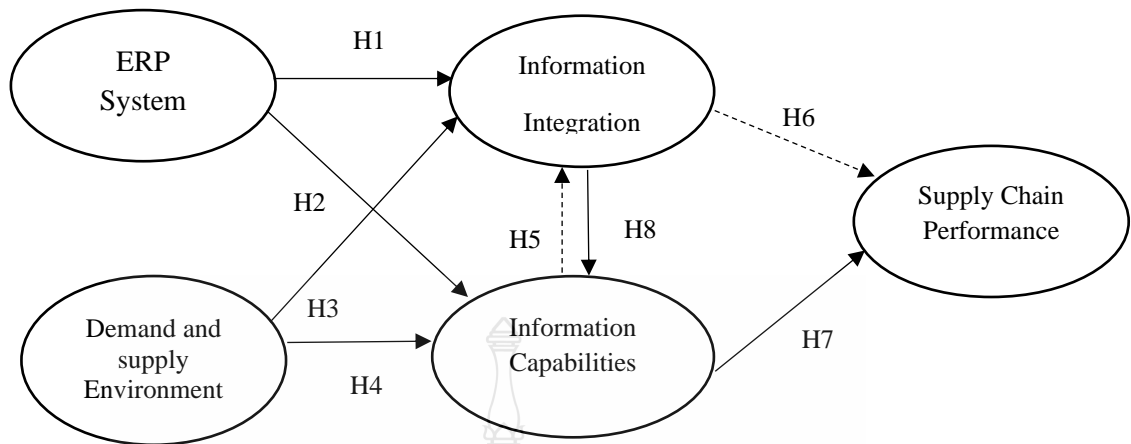


significant positive relationship between information integration and information capabilities, and therefore, hypothesis H8 is supported.

Supply chain performance is a dependent variable of the model, while observed variables for firm performance measurement become the greatest challenges for strategic management research due to the wide variety of concept and definition of firm performance. The variables used for this study are profitability, market share, customer satisfaction, and employee satisfaction. All these aspects of firm performance have been thoroughly reviewed from the earlier relevant studies and have been found to represent a good measurement for firm performance construct. The summary of the hypothesis testing results is shown in Table 4.26.

**Table 4.26** Hypotheses testing results

Hypothesis	Result
H1: There is a positive relationship between ERP system and information integration.	Supported
H2: There is a positive relationship between ERP system and information capabilities.	Supported
H3: There is a positive relationship between demand and supply environment and information integration.	Supported
H4: There is a positive relationship between demand and supply environment and information capabilities.	Supported
H5: There is a positive relationship between information capabilities and information integration.	Not Supported
H6: There is a positive relationship between information integration and supply chain performance.	Not Supported
H7: There is a positive relationship between information capabilities and supply chain performance.	Supported
H8: There is a positive relationship between information integration and information capabilities	Supported



**Figure 4.5** Graphical presentation of tested hypotheses

The figure 4.5 illustrated the graphical presentation of tested hypotheses. The solid line indicates the supported hypotheses (H1-H4 and H7-H8). Therefore, the dashed line indicates the unsupported hypotheses (H5-H6).

#### **4.11 Qualitative Results**

This was the part of qualitative research. This study was an in-depth interview guideline on the executives or top manager from five frozen food industry in Thailand. The results from the interview were summarized and brought to confirm the quantitative research. The qualitative research results through in-depth interviews confirming the quantitative research results.

##### **4.11.1 Research Tools**

The research tool here was the semi-structured interview which is the interview that is previously set for the main questions as the guideline to conduct the interview by it can be added or adjusted according to the properness during the interview. There were 4 items of interview questions explained in chapter 3.

##### **4.11.2 The Executive Manager In-dept Interview Results**

The following is a detailed explanation through interviews with executives or top manager from five frozen food industry in Thailand

**Table 4.27** Results of the in-depth interview question 1

“In what areas does your business benefit from the integration of information and capabilities, and how do you think it affects your operations?”

<b>Participant</b>	<b>Answer for the question</b>
Top manager company 1	In the short term, the industry uses the information integration and information capabilities in ERP System to process the purchase Order and predict to demand and supply to supporting the supply chain ability, and there use this information to forecasting the supply chain and matching the demand and Supply in the long term
Top manager company 2	ERP use to prepare the balance sheet for closing the balance sheet within 15 days of every month. That focus on reducing the amount of inventory in stock for serve the funds to circulate in another department. Furthermore, we use information of sales and marketing in the ERP system about 4 years to analyze and design the appropriate warehouse sizing. Therefore, the industry to use the ERP system. Can help the businesses to manage the supply chain performance from the upstream to downstream, saving cost, make more efficiency and competitive advantage
Top manager company 3	The company focuses on Big Data within the organization, where those data will be taken into account in terms of managing inventory to consistent with the supply chain, focusing on managing sufficient inventory for each supplier's order cycle.
Top manager company 4	The information of demand environment in the ERP system is used to adjust the strategy of the organization from frozen food only to ready-to-eat food. That is meet the current food consumption behavior that requires convenience and speed
Top manager company 5	Frozen food must analyst and integration information capabilities through supply chain, both imported and manufactured in Thailand. Them use information from in ERP system to control the temperature of fresh food from the source of raw materials to the factory until it is processed into frozen food products. which will have temperature control throughout the delivery of products to consumers through frozen food freezer.

**Table 4.28** Results of the in-depth interview question 2

“Why is it important for your organization to formulate policies or guidelines for information integration and information capabilities?”

<b>Participant</b>	<b>Answer for the question</b>
Top manager company 1	The integrates of information of demand and supply environment in the ERP of the organization, it is very important and useful in real time information to respond to customers immediately. Furthermore, we will be able to predict some impact risks in response to future customers.
Top manager company 2	Implementation of ERP in marketing. The company can analyze the actual demand of the product. The data obtained from the analysis is an important mechanism for driving products and generating clear revenues. It allows us to delve into the buying behavior of our customers and forecasting the sell.
Top manager company 3	Determining a policy on the integration of information from information systems can help with inventory management. If the stock of products is sufficient to meet the demand It will allow us to have better sales. But if any product that slow movement, this will try to delete it for increate the new items to the market.
Top manager company 4	From the analysis of changing consumer behavior of customers found that, the number of frozen food orders in the country has decreased. As a result, the company had to adjust its sales strategy to be able to respond to the consumer needs immediately. The company has used the online strategy marketing for serve the customer needs. Them used the data of the demand and supply environment to online advertising marketing, which has a dedicated team on the website to interact with customers. when customers order food online. The chef will prepare ready-to-eat meals and deliver food by delivery teams, about 1 hour. This is the strategy of respond to the consumer needs.
Top manager company 5	The information of frozen food must be kept at a temperature below $-18^{\circ}\text{C}$ ( $=0^{\circ}\text{F}$ ) at all times. In order to prevent microorganisms and prevent the formation of new ice crystals, which is a major cause of deterioration in product quality. Freezing food, hygiene of refrigeration, packaging and storage, as well as distribution. The key of frozen food is freshness of raw materials and preserving food quality according to standards and consumer safety.

**Table 4.29** Results of the in-depth interview question 3

“Does your organization have a plan or approach to information integration and prioritize information capabilities?”

<b>Participant</b>	<b>Answer for the question</b>
Top manager company 1	Using the ERP system is an organization management program. There must be a clear reason for what purpose, the company will use the work. When the data is stored in same database It is information gathered from all parts together. which must be analyzed and transformed into other types of information suitable for use.
Top manager company 2	ERP is a comprehensive system and associated with different types of software and link other systems in each department. It can reduce costs and improve efficiency of proper warehouse design. Furthermore, It can analyze the profitability per unit.
Top manager company 3	Regarding the information integration and information capabilities, the company has a plan in both the overview and the product by store section in order to manage the storefront and the sales area. This requires management information to achieve maximum sales per square meter and is used to adjust the layout of the storefront space as suitable.
Top manager company 4	The company use information of ERP System , such as sending orders to a supplier or manufacturer, planning stock management. Executives place great importance on in-house information technology because all the work is done through the whole system.
Top manager company 5	ERP systems can integrate data from every segment together. And can be processed according to the requirements. ERP system allows data to be in the same database for further use in order to make the data flow according to the production and distribution process.

**Table 4.30** Results of the in-depth interview to recommendations to further research

<b>Participant</b>	<b>Answer for the question</b>
Top manager company 1	They expect the research results or research to support which ERP program is suitable for any type of business. Because each organization uses different programs, or some organizations use multiple programs together. It can be time consuming and costly to customize processing methods to obtain appropriate information for each module administration. This research will help guide each industry to choose a program that is more suitable and better aligned with their operations.

**Table 4.30** Results of the in-depth interview to recommendations to further research  
(Cont.)

<b>Participant</b>	<b>Answer for the question</b>
Top manager company 2	I would like to have the research that shows, the importance of using an ERP system to increase the efficiency of each company and to make every company understand the benefits of the chosen ERP system. Therefore, every company must have a clear policy that wants to bring ERP to help solve any problems. What areas does the company need useful information? As well as clarifying for employees to understand together otherwise there will be a lack of cooperation, lack of understanding, and lack of faith in the use of the ERP system. Cause the organization to waste budget and useless. Therefore, the organization must analyze the information obtained from the system in order to monitor work processes and plan the needs of stakeholders for increase the competitive advantage.
Top manager company 3	Information integration and information capabilities of supply and demand environment from the ERP system in the frozen food industry. It is necessary to respond to predictions and cut the risk of managing and distributing products to consumers for maximum efficiency. In addition, this will tell you about the shelf life of frozen food, stock on hand and the product lower than in stock. That referring to the basic functions of the system, the company must use that information to be a pilot to control inventory and analyze non-performing goods in the supply chain.
Top manager company 4	Keeping the frozen food temperature below minus 18 degrees will help to preserve the fresh food and make the product quality as efficient as possible. From the receipt of raw materials and the temperature is controlled throughout the process in the factory production. This makes the product safe from the growth of microorganisms. It has been standardized that can be exported around the world. Product quality and taste of food is part of the study on demand and supply environment of frozen food business.
Top manager company 5	Minus 18 degrees Celsius in frozen food. It prevents microorganisms and prevents the formation of new ice crystals that are a major cause of product deterioration. Therefore, the quality of raw materials, raw material preparation, how to freeze frozen, food Hygiene of the infusion, packaging and storage, and as well as product distribution. It is an important factor in the production of quality frozen food and it is the success factor in distribution that meets standards and is safe for consumers.

### **4.11.3 Working Hypothesis**

After interviewing the first executives or operation manager the working hypothesis was created as shown in the following.

Working hypothesis 1: In your business benefit from the integration of information and capabilities, and you think it affects your operations. Working hypothesis 1 was analyzed based on answer 1. From question 1 shows that the company is focuses on the utilization of information in the ERP system to control, and improve the operation as well as in increasing the supply chain performance.

Working hypothesis 2: The important of your organization to formulate policies or guidelines for information integration and information capabilities. This working hypothesis was analyzed from Question 2 by Question 2 the executives indicates that. The policies are very important and useful the real time information to respond to customers immediately. which, we will be able to predict some impact risks in response to future frozen food industry.

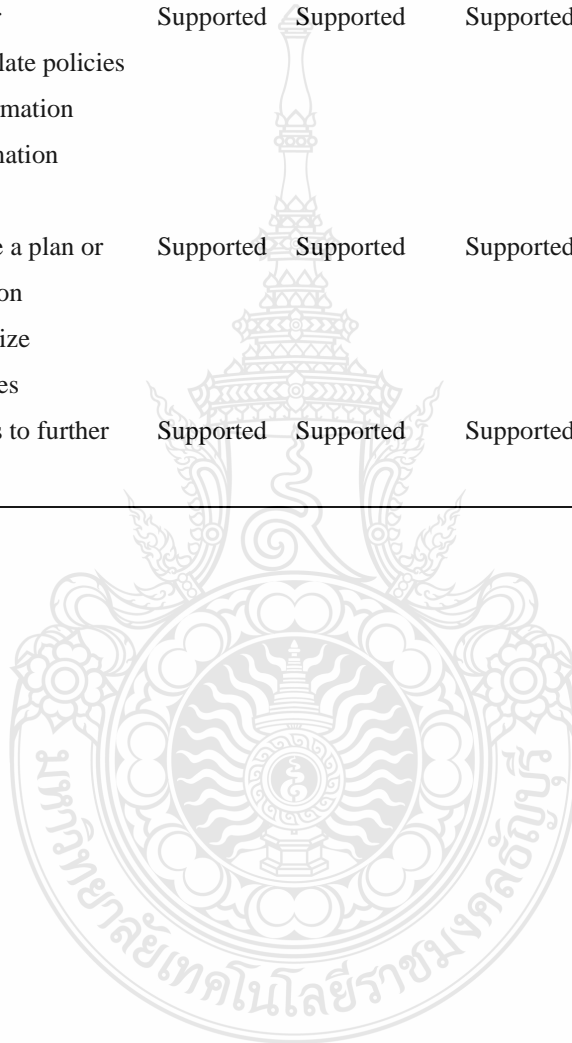
Working hypothesis 3: The organization have a plan or approach to information integration and prioritize information capabilities. This working hypothesis is analyzed from the first two questions. From the 3rd question, it shows that the company, that the information integration and prioritize information capabilities can be done to respond to support and improve the operations of the frozen food industry.

Last question, the recommendations to further research from the in-depth interview. The company want to be used the information from future research to be a pilot to analyze for choose best and flexible of ERP system to control inventory requirement suitable for stakeholders in each industry.

Therefore, the interview with the executive on this working hypothesis had showed that all hypotheses were supported and the results were confirmed as well encouraged, indicating that the result of the interviewing was justified. The summary of hypothesis test is shown in Table 4.31.

**Table 4.31** Working hypotheses testing

<b>Working Hypothesis</b>	<b>First top manager</b>	<b>Second top manager</b>	<b>Third top manager</b>	<b>Fourth top manager</b>	<b>Fifth top manager</b>
In your business benefit from the integration of information and capabilities, and you think it affects your operations.	Supported	Supported	Supported	Supported	Supported
The important of your organization to formulate policies or guidelines for information integration and information capabilities.	Supported	Supported	Supported	Supported	Supported
The organization have a plan or approach to information integration and prioritize information capabilities	Supported	Supported	Supported	Supported	Supported
The recommendations to further research	Supported	Supported	Supported	Supported	Supported





## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATIONS**

Chapter five presents the conclusion and discussion of the findings. In addition, the chapter links the results with information integration and information capabilities with the ERP system, and the demand and supply environment for the supply chain performance by focusing the study on a group of frozen food industrial businesses in Thailand. This chapter is organized into four sections. The first covers methodology and a summary of research findings. The second section contains a discussion of the research findings. The third section focuses on the implications and benefits derived from the study findings, as well as business guidelines for firm operations, and the last section discusses the limitations of the study and future research recommendations.

#### **5.1 Conclusion**

This research aimed to study: 1) the management of information systems, in the context of resource-based perspective theory, in the field of information integration and information capabilities; 2) to develop the appropriate and perceived usefulness of information integration and information capabilities in the supply chain system; 3) to examine the relative significance between information integration and information capabilities of demand and supply environments in ERP systems and supply chain performance of the frozen food industry in Thailand; 4) to investigate how information integration and information capabilities facilitate ERP system capabilities; and 5) to investigate the effects of information integration and information capabilities as mediators and their impact on supply chain performance of the frozen food industry in Thailand.

This research is based on the perspective of Resource-Based View (RBV) and aims to clarify the process of supply chain operation through the analysis of the information exchange during communication and its resulting effects on the performance of the frozen food industry in Thailand. Furthermore, the objectives have been realized with the conclusion that the RBV perspectives are confirmed and the supply chain performance is reliable and relevant.

The study conclusion showed that information from the ERP system and the demand and supply environment had an impact on information integration and information capabilities. Information integration and information capabilities are factors effecting ERP system, enhancing supply chain performance in the demand and supply environment. The study showed that, to become an information capability, companies in the frozen food industry should integrate demand and supply information with the ERP system providing comprehensive information across all departments, store information in a timely manner, and use a database management system to support operational decision-making. Information integration and information capability, based on flexible and reliable information, will support supply chain operations with good performance.

## **5.2 Discussion**

According to the research model, information integration and information capabilities are used as a mediator for the ERP system and the demand and supply environment for the supply chain performance. The following hypotheses were tested to clarify the research questions.

This study has already raised three major research questions, which are:

- 1) Do ERP systems and demand and supply environments affect supply chain performance through information integration?
- 2) Do ERP systems and demand and supply environments affect supply chain performance through information capabilities?
- 3) How ERP systems and demand and supply environments affect supply chain performance through information capability and information integration?

Furthermore, eight hypotheses were established and statistically tested, and the results are as follows:

**Table 5.1** Summary of research questions, hypotheses testing and results.

Research questions	Hypothesis	Result
1) Do ERP systems and demand and supply environments affect supply chain performance through information integration?	H1: ERP system has a positive effect on information integration.	Supported
	H3: Demand and supply environments have a positive effect on information integration.	Supported
	H6: Information integration has a positive effect on supply chain performance.	Not Supported
2) Do ERP systems and demand and supply environments affect supply chain performance through information capabilities?	H2: ERP system has a positive effect on information capability.	Supported
	H4: Demand and supply environment has a positive effect on information capability.	Supported
	H7: Information capability has a positive effect on supply chain performance.	Supported
3) How ERP systems and demand and supply environments affect supply chain performance through information capability and information integration?	H1: ERP system has a positive effect on information integration.	Supported
	H2: ERP system has a positive effect on information capability.	Supported
	H3: Demand and supply environments have a positive effect on information integration.	Supported
	H4: Demand and supply environment has a positive effect on information capability.	Supported
	H5: Information capabilities have a positive effect on information integration.	Not Supported
	H6: Information integration has a positive effect on supply chain performance.	Not Supported
	H7: Information capability has a positive effect on supply chain performance.	Supported
	H8: Information integration has a positive effect on information capabilities.	Supported

This section provides the results in interpretation, discussion, and conclusion of the research questions.

### **5.2.1 The ERP System and Demand and Supply Environment affect the Supply Chain Performance through Information Integration.**

The ERP System facilitates the utilization process of the organization's resource planning so that the information integration of the ERP System and the demand and supply information can be applied. This improves resource management effectiveness, which raises overall productivity and collaboration, boosts supply chain performance, and increases competitive advantage. Therefore, lead time operations reduction is imperative to improve operations in the supply chain. For this reason, the uncertainty in the supply chain operations is eliminated, and the information contained in the ERP system is integrated and becomes the ultimate goal of supply chain management and overall performance. Information integration and supply chain performance can be improved by literary analysis, whereby companies are able to share critical information, resulting in changed behaviors, learned, and improved supply chain efficiency in the frozen food industry. According to Industry 4.0 (Liao, Deschamps, Loures, & Ramos, 2017), information integration in the ERP system as well as the demand and supply environment of each department are directly correlated with the supply chain performance. Three hypotheses have been developed to validate direct correlation. ERP systems and demand and supply environments are directly related to supply chain performance through information integration. The ERP system, as well as the demand and supply environments, are directly related to information integration. But information integration and supply chain performance do not show a direct correlation. The result is that the analysis of the relationship between information integration and supply chain performance indicates that there is no positive relationship between the variables. The results confirm that information integration does not positively affect supply chain performance. Therefore, that is not supported. It is possible that the respondents did not prioritize the quality of the information because doing so required standards for integrating information into a uniform and creating explicit practice. This creates a competitive advantage in the same industry. Another reason may be that the organization fails to convey an information strategy, share information, and improve information

quality all at the same time. Such a lack of information utilization is in line with Montero's (2019) research findings that the quality of information systems impacts organizational performance. This is also congruent with the findings of Gunasekaran and Ngai (2004) that information systems not only create the greatest benefits but also enhance competitiveness. It is therefore crucial that a communication system policy be established for all stakeholders to realize the effects of information utilization and sharing within the organization throughout the chain.

### **5.2.2 The ERP System and Demand and Supply Environment affect the Supply Chain Performance through Information Capability.**

ERP includes all components of communication within the organization that enable each subdivision to share information necessary for effective operation. This also makes it possible to make the best decisions, which improves competitive advantage, increases added value, and reduces both costs and risks for the whole supply chain. This is supported by Diabat et al. (2017) that business success results from information utilization capabilities and the mobilization of assets, people, and processes to form total systems of operation.

Consequently, RVB encompasses all the resources of the organization that are integrated, resulting in the best way of utilization and leading to sustainable competitive advantage (J. B. Barney & Clark, 2007). At the same time, RVB should possess the following VRLO characteristics:

- 1) Value: the value and resources created and integrated throughout the organization.
- 2) Rareness: the scarcity, which makes it hard to find.
- 3) Limitability: the uniqueness, which makes it hard to copy.
- 4) Organization: the ability to establish expertise that is exclusive.

Therefore, VRLO can be used to assess the competitiveness of an organization, and as a result, the ERP system as well as the demand and supply components have a direct effect on the supply chain performance through information capabilities. While Ives and Learmonth (1984) indicated that an organization can integrate data from different departments to make informed decisions, encourage responses from customers, and serve the service provider's needs, they discovered higher business unit collaboration.

Many scientific studies also support the relationship between ERP data integration and the demand-supply environment on improved performance. For example, Porter (1991) advised companies to apply ERP systems to improve business operations. In this light, information integration is consistent with RBV Theory as it is unique and cannot be replaced (J. B. Barney & Clark, 2007). It is also effective for the supply chain because it attracts customer demand as well as increases chain capabilities (Croxtton, Lambert, García-Dastugue, & Rogers, 2002).

### **5.2.3 The ERP System and Demand and Supply Environment affect the Supply Chain Performance through Information Capability and Information Integration.**

The results of the study showed that information integration had no direct correlation with supply chain performance. However, when the arrow was reversed from the information integration to the information capabilities, the relationship was positive. Thus, the demand and supply environments include all the information within the organization that is linked and integrated so that all aspects of the supply chain reach optimization. Similarly, Tonsakun-aree, Jaturat, and Kuntonbutr (2021) emphasize the important role of information competence in ERP systems as well as the strategic supply and demand environment within the dynamics and competition of business. This consists of the summary of qualitative research. The executive commented that companies need to focus on the policy of information integration and information capabilities of all departments together, for sharing information with each other within the organization, and coordination with the supply and demand environment of stakeholders. Businesses can use the information in the ERP system to achieve benefits over competitors in the same industry. Mentzer et al. (2001) also stress the dominant role of information capabilities in improving productivity and efficiency to generate long-term profitability and competitiveness. Organizations must study information capabilities and other variables to improve the efficiency of their work. It has an integrated network for knowledge sharing in the same industry. The results were supported by a relevant study by Fawcett, Osterhaus, Magnan, Brau, and McCarter (2007), which examined the impact on customers at the center of the relationship between information competence and the performance of a stable supply chain. The results also provided a critical answer to this

research question, where the power of information provides "peace of mind.". Additionally, they supported the positive correlation between the supply and demand environment and supply chain performance. From the ability to obtain information, it has been shown that information capabilities are correlated with the company's supply chain performance. Some studies, such as some researchers', reported a positive correlation between information capabilities and performance. Furthermore, they found that the information capabilities of different industries led to a better correlation between data competence and business-appropriate performance. Under these RBV perspectives, business operations that control performance in information capabilities are dominant. Tonsakun-aree, Jaturat, and Kuntonbutr (2020) also pointed out that the extent of data exchange as a company ability to exchange knowledge with business partners and effective information exchange are among the core competencies in business processes. In addition, according to Ravichandran et al. (2005), a study that analyzes the relationship between information capabilities and the efficiency of supply chains, information capabilities have a profound effect on supply chain performance.

On the other hand, Esper, Fugate, and Davis-Sramek (2007) contended that it is most unlikely that firms could apply their information capabilities strategically in the constantly changing business environment in an increasingly hypercompetitive ERP system at present.

### **5.3 Contribution**

The empirical results from the model, supported by qualitative information, provide several contributions to topic as follows.

#### **5.3.1 Theoretical Contribution**

There are some implications for the theory from the results in many ways. The study provides additional evidence to support the resource-based views. As it has been established, RBV is the basis for companies that are successful in developing their uniqueness, which contributes to competitiveness. If a company has non-profitable resources, the RBV theory can explain the difference in efficiency. It is therefore appropriate to perform a hypothesis test on empirical data to prove the efficiency of the industry. Superior industry performance must be achieved through the integration of the

industry's internal and external data capabilities. It will benefit the most, as supported by J. B. Barney and Clark (2007), if companies have the ability to accumulate and share resources. Information that is valuable, rare, imitable, and non-substitute (VRIN) will lead to a competitive advantage. The company must identify resources with VRIN and apply them. Fortunately, the nature of the frozen food industry in Thailand has been aligned with the RBV perspective. This represents strong support for the critical role of the ability to integrate logistics. The findings of this study show a positive correlation between core logistics competence and logistics integration when it comes to collaboration and integration of other logistics competence companies. Moreover, the positive correlation between logistics integration and company efficiency confirms the integrated study of Rosenzweig et al. (2003).

The results of the study indicate that information integration does not directly support supply chain performance, but the findings show that the company cannot rely solely on information integration. Therefore, the company needs collaboration between information capabilities and information integration. As for the ability of information to correlate directly with supply chain performance, this means that information capabilities are different. That is why the capability of information still has direct correlation with supply chain performance, without having to integrate information in the industry, which is possible.

The results have also been consistent and in support of Ince et al. (2013) that confirm the importance of supply chain performance. Every participant must work closely together and develop effective integrations within and outside the departments to increase their ability to translate their abilities into competitive benefits, efficiency, and profitability to result in superiority (Ince et al., 2013).

### **5.3.2 Practical Contribution**

The findings have identified significant business operations. In today's global economy and in a challenging competitive environment, it is imperative for entrepreneurs to reinvent their business operations. The company's shows that companies should leverage their resources and capabilities to create value to gain and maintain superior performance.



Managers at all levels must be aware of the potential of information competence, both internal and external, to enable the company to achieve superiority. The major components of a resource-based perspective of value are: rare, inimitability, and irreplaceability, which provide a theoretical premise. Therefore, management should assess the capabilities within the organization through this theoretical framework. In order for the industry to achieve superior performance, it must be able to identify the information capabilities it currently has. RBV can become the operational process within the industry with internal capabilities and strength. The executive level, information integration, and information capabilities are used to analyze and forecast the demand and supply environment in order to meet the needs of stakeholders in the same industry. This is the strength of the information policy to support the management and operations to work together from upstream to downstream, which uses this to plan for increasing the efficiency of business processes throughout the supply chain. At the level of operation, they can use this information to manage and integrate all of the information organizationally to support the stakeholder requirements. Consequently, it serves to manage the business process to deliver with the least amount of time and lowest cost possible, increasing the supply chain performance.

This study examined the relationship between information capabilities and the efficiency of the supply chain. The results suggest that information competence is an area that can create a powerful foundation that leads to superiority. They may have some problems concerning integrating corporate may have occurred, but fulfilling customer satisfaction should be the goal. It is important for management to understand the needs of the customer and identify those needs. This capability includes reliability, delivery, punctuality, and responsiveness. Once the quality of information for customers information capabilities is able to meet the industry effectively, it is possible to manage the stakeholders according to strategic planning, utilization of resources, and performance assessment in terms of the distributor equity, the strategic supplier alliance, the distributor communication, and the supplier relationship. Information capabilities to acquire, deploy, and utilize the existing enterprise assets, their optimal use, as well as adapt to the changing needs of the new technology direction, are another key competence that industry executives need to possess. Information competence refers to the ability to integrate and

accommodate industrial infrastructure, including sharing information within and outside the organization.

## **5.4 Research Limitations and Suggestions for Future Research**

### **5.4.1 Limitations of the Study**

There are some limitations of this study for future research to be considered as follows:

First, regarding the items used for mediating variables, even with a thorough review of the relevant literature, it is likely that the items selected and used in data collection tools and models may be biased and not be a good substitute for a mediating variable.

Second, information integration has a multi-dimensional structure. There could be many other elements involved in this study. The relationships between the selected variables can be very positive and have a large impact on the performance of a company's supply chain.

Finally, management and directors as respondents may not be a good representative of the industry because they may have knowledge and understanding about the information integration and the use of information capabilities in the same industry in different ways.

### **5.4.2 Future Research**

The suggestion for future research, from the limitation of information integration, has a multi-dimensional structure. Relationships between the selected variables can be very positive and have a large impact on the performance of a company's supply chain, which, further research may examine other dimensions of information integration that will not influence the performance of the supply chain.

In addition, management and directors, as respondents, may not be a good representative of the industry. Prospective researchers may need to consider average scores from more than one respondent of companies responding to the same questionnaire. More accurate information and the reduction of bias are necessary.

Furthermore, this study is specifically based on resource-based views, which can provide further explorations in competitiveness, productivity, marketability, information integration and capabilities, enabling each organization to become unique

and irreplaceable. However, it is advisable to take cross-functional integration of individual company-specific capabilities into consideration. Through doing so, there will be more findings of mediating variables that can influence other capabilities for future research.

Finally, the scope of the present study is limited to the frozen food industry only. It is therefore desirable that other industries be investigated to reveal further insights that are obtainable from this study.



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