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Effect of Supply Chain Performance through a Demand and Supply Environment Derived from the ERP System of the Frozen Food Industry in Thailand

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ABSTRACT

The goal of this research is to verify that the efficiency of the supply chain in the frozen food industry of Thailand relates to Enterprise Resources Planning (ERP) systems, which are independent variables, while the information from the demand and supply environment provides mediator variables. Samples were collected from 234 small, medium, and enterprise companies in the frozen food industry of Thailand. The respondents for this study are groups of top executives, middle and operational management and employees utilized within the ERP systems. The data were analyzed by using the Structural Equation Modeling (SEM) method and differed in statistical coefficient, The result of regression weight studies significantly confirmed that the ERP systems had a direct effect on supply chain performance. However, the demand and supply environment also demonstrated indirect relationships with the supply chain performance. In summary, organizations must integrate the model of Enterprise Resource Planning by studying each situation of demand and supply. Furthermore, this model has analyzed the potential of the industry resources for generating sustained competitive advantage for the frozen food Industry in Thailand. Furthermore, the information of the demand and

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supply environment in the Enterprise Resource Planning (ERP) system confirmed the business value chain in each process and increased the supply chain performance.

Keywords: Supply Chain Performance, Enterprise Resource Planning, Demand and Supply Environment, Frozen Food

Background and Significance of the Research Problem

In 2017, the Office of the National Economic and Social Development Council positioned Thailand's frozen-food industry as a growing and valuable industry, with highly competitive advantages for export. Nowadays, many industries rely on information technology, such as the ERP system, to manage information from the demand and supply environment to gain a competitive advantage. These organizations utilize both internal and external information to collaborate with the demand and supply environment in order to achieve effective supply chain management (Zhou, Dan, Ma, & Zhang, 2017). The frozen food industry in Thailand can improve supply chain processes by collecting data from the work processes of various departments and using them to increase efficiency of organizational resource planning (Yuan, Zhang, & He, 2015). Information from each process can be integrated into an important database for executive decision-making in order to achieve efficient operation and high-quality supply chain management (Yang & Maxwell, 2011). All related departments must be able to analyze and extract useful information from the demand and supply environment and use it to increase the value chain and competitive advantages in the frozen food industry. Therefore, the information from the demand and supply environment is important at the time the organization collects data and creates the information database in order to analyze them for a decision support system for all departments in order to improve the quality of the performance of the frozen food industry in Thailand. Furthermore, the researchers Ince, Imamoglu, Keskin, Akgun, and Efe (2013) considered the possibility of using data in ERP systems for resource planning to allocate and track operations according to the demand and supply environment of each industry. In addition, the research results showed that the ERP system can link various data in the organization into the same database. It can reduce redundant workflows and reduce operational errors, helping to solve problems in presenting information effectively. This allows the industry to use ERP data and data from the supply and demand environment to effectively manage processes throughout the supply chain. Moreover, the industry can use that information to gain a sustainable competitive advantage to make their industry different than competitors according

to theory a resource-based view (RBV) on the use of resources of an organization in four areas: valuable, rare, inimitable, and non-substitutable.

Research Objectives

1. To study the performance of supply chains enhanced by the processes of the enterprise resource planning system (ERP).

2. To confirm that the information from the ERP system, together with demand-and-supply environment, are able to enhance and improve the performance of the supply chain in the frozen food industry in Thailand.

Scope of Research

This study is focused on verifying that the efficiency of the supply chain relates to enterprise resources planning (ERP) systems and the demand and supply environment, which are independent variables, while the information from the demand and supply environment provides mediator variables. This is information from the business environment related to stakeholders from the demand side and supply side. It impacts from upstream to downstream. The information from the demand and supply environment in the ERP system is a key component of business to increase the opportunities to manage supply chain performance and increase the competitive advantage (Diabat & Al-Salem, 2015). The samples and target population groups were executives, middle managers, operational managers, and operators collected from 234 small, medium, and enterprise companies in the frozen food industry of Thailand. The data were analyzed by using the SEM (Structural Equation Modeling) method.

Hypothesis

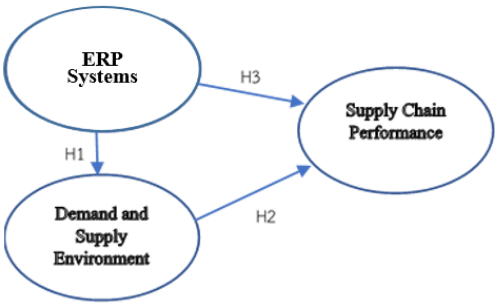


Figure 1 Research Framework

Figure 1 shows the research hypothesis**,** and contains 3 hypotheses as follows:

H1: The ERP system has a positive effect on the demand and supply environment

H2: The demand and supply environment has a positive effect on supply chain performance

H3: The ERP system has a positive effect on supply chain performance

Research Methodology

A. Population and Sampling

ERP systems are utilized by top, middle, and operational management, along with employees, and these groups were comprised of the respondents for this study, which focuses on the frozen food industry in Thailand. The sample size for this study consisted of 234 subjects, divided into 10 groups. The sample size was calculated according to the rules of a structural equation model (SEM), which relies on the number of general independent parameters to calculate the sample size. The ratio of the sample size to the number of independent parameters is 10:1 The sampling distribution from each section of the frozen food industry is based on the weighted proportions.

B. Research Tools

A questionnaire was obtained from literature review, and it contains three parts: ERP System, Demand and Supply Environment, and Supply Chain Performance.

C. Variables

The questionnaire was developed from literature review in the area of ERP systems and supply chain performance through demand and supply environments. The research model was created with three main groups of latent variables. The first group of variables, ERP systems, emphasized using information from the ERP system to enhance cooperation with others (ERPOrg1), manage personnel rotation between departments to enhance knowledge and ability of emplyees (ERPOrg2), and improve production capacity based on demand and supply (ERPOrg3). The second group of variables, demand and supply environment, focused on how the companies utilized the demand and supply information in customer relationship management (DSERela1), communication management (DSEComm1), product and service readiness (DSECusInfo), matching customer needs (DSECus), on-time delivery (DSETime1), speed and accuracy (DSETime2), and delivery quality and cost (DSEDeli). The third group of variables, the firm's benefit, involved improving supply chain performance in response to customer needs

(SCPFlex1), improving the ERP system for supply chain performance (SCPFlex2), forecast reliability (SCPReli1), and confidence in supply chain performance outcomes (SCPReli2).

D. Validity and Reliability

1) Content Validity Testing

The questionnaire was assessed and adjusted by five experts in this field according to the IOC (Index of item-Objective Congruence) which refers to the consistency between a question and its objective. Based on values between -1 and 1, each question that is content-relevant will have an IOC index approaching 1. If any question has an IOC index below 0.7, it needs to be revised (Rovinelli & Hambleton, 1976).

2) Convergent Validity

Convergent Validity with Confirmation Factor Analysis was measured by the researchers. This research model meets the criterion, which demands that the value of the factor loading must be greater than 0.6 (Hulland, 1999), and the AVE is greater than 0.5. For this study, the factor loading values ranged from 0.57 to 0.89, while the squared correlation values ranged from 0.090 to 0.618. Table 1 illustrates the construct model for Convergent Validity testing with Confirmation Factor Analysis.

Table 1 Factor Loading of all Latent Variables

Variable	Factor Loading	AVE	Variable	Factor Loading	AVE
ERP Systems		0.741	D&S Environment		0.84
ERPOrg1	0.80		DSERela1	0.65	
ERPOrg2	0.89		DSEComm1	0.57	
ERPOrg3	0.89		DSECusInfo	0.75	
SC Performance		0.482	DSECus	0.77	
SCPFlex1	0.88		DSETime1	0.71	
SCPFlex2	0.85		DSETime2	0.78	
SCPReli1	0.77		DSEDeli	0.61	
SCPReli2	0.75				

3) Discriminant Validity

The assessment of discriminant validity was estimated by comparing the Average Variance Extracted (AVE) value, with the square of the correlation between variables. Fornell

and Larcker (1981)) suggested that the values of the square root of AVE should be higher than values of the square of the correlation which, as mentioned, supports the discriminant validity (Andreev, Heart, Maoz, & Pliskin, 2009).

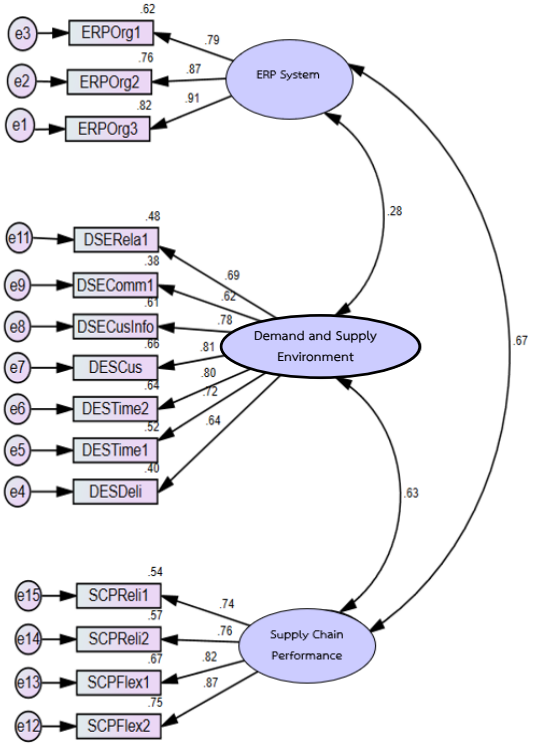


Figure 2 Confirmation Factor Analysis

Figure 2 shows a diagram of the test model, which utilizes ERP System, Demand and Supply Environment, and Supply Chain Performance and is then evaluated by confirmatory factor analysis.

4) Multicollinearity Testing

This regression analysis has limitations on each variable, none of which may be related to other variables. This is tested by using The Tolerance and Variance Inflation Factor (VIF) mensuration. The Tolerance must be more than 0.1, or VIF must be less than 10 (VIF = 1 / Tolerance) to admit a no-multicollinearity-problem conclusion. Regarding this, Multicollinearity testing for unrelated relationships between variables via the Variance Instruction Factor (VIF) with values between 1.238 - 3.235 indicated that there was no multicollinearity between variables.

5) Reliability Testing

Reliability testing is used to measure reliability in the qualification of measurement scales and factors used in preparation of information, and it is related to the relationship among individual items in the scale of Cronbach's alpha coefficients to set the reliability scale. If the result of the Cronbach's alpha testing is equal to or higher than 0.7, then the answer has conformity (George & Mallery, 2003). Reliability was tested twice in this study. The first test involved sampling 30 questionnaires in order to improve the definitions in which the test results were less than 0.7. The second test was performed after all sampling data were collected; reliability testing was performed again.

Results

The Construct Model

The model was created to measure both direct and indirect positive effects of the ERP system on supply chain performance through the demand and supply environment.

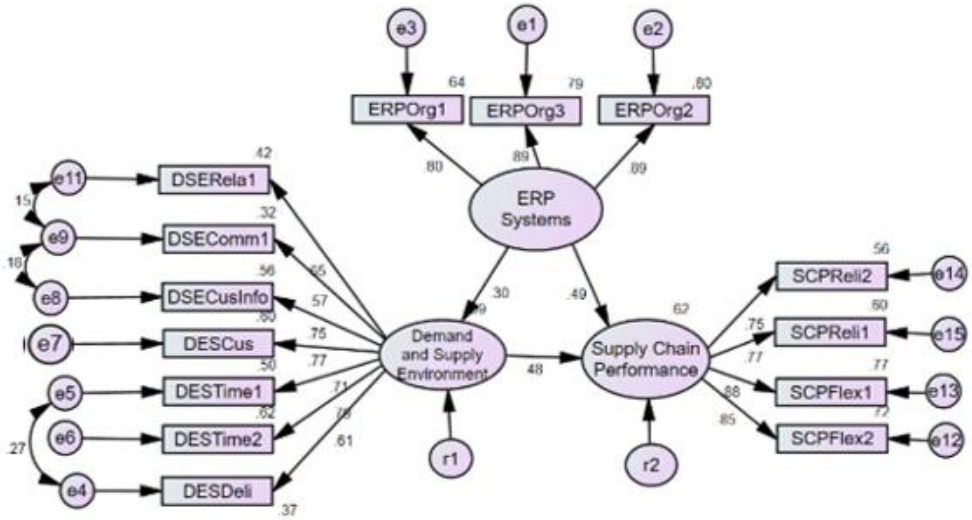
The results of tested standardized direct effect, indirect effect, and total direct effects are shown in Table 2.

Table 2 Standardized Direct Effect, Indirect Effect and Total Effects among variables.

		Standardized Direct Effect			**Standardized Indirect Effect**			**Standardized Total Effects**		
	R^2	ERP	DSE	SCP	ERP	DSE	SCP	ERP	DSE	SCP
ERP	-	-	-	-	-	-	-	-	-	-
DSE	.090	.300	-	-	-	-	-	.300	-	-
SCP	.618	.491	.484	-	.145	-	-	.636	.484	-

Table 3 shows that at a statistically significant level of 0.05, the ERP system has direct effect on the demand and supply environment = 0.300, on supply chain performance = 0.491, and that it has a total effect on supply chain performance = 0.636, whereas the demand and supply environment have direct effect on supply chain performance = 0.484.

The result leads to the conclusion that the ERP system affects the supply chain performance through the demand and supply environment.



CMIN/DF = 2.956, GFI = 0.920, AGFI = 0.847, RMSEA = 0.092, NFI = 0.927

Figure 3 Research Model Results

Figure 3 shows the results of the three latent model tests evaluated by structural equation modeling. Based on the assessment, the model is a good fit, represented as follows: Chi-Square = 162.583, df = 55, CMIN/DF = 2.956, GFI = 0.920, AGFI = 0.847, NFI = 0.927, CFI = 0.949, RMR = 0.082, RMSEA = 0.092 (PCLOSE = 0.000), and Hoelter = 118 (0.01). Therefore, the structural equation model is accepted. The results from the measurement model show in Table 3.

Table 3 Assessing the model fit indicators

Indicator	Value
Chi-square/Degree of freedom (CMIN/df)	2.956
Goodness of Fit Index (GFI)	0.920
Adjusted Goodness of Fit Index (AGFI)	0.847
The Root Mean Square Error of Approximation (RMSEA)	0.092
Normed Fit Index (NFI)	0.927
Comparative Fit Index (CFI)	0.949

Hypothesis Result

The hypothesis of this study was tested by Structural Equation Models (SEM). To determine the presence of mediating the effect, the path coefficient was compared between the model with and without the mediating variable, which was demand and supply environment in this study. The hypothesis test results show that:

H1: The ERP System has a positive effect on the demand and supply environment. This hypothesis is supported by standard regression weight of 0.30 ($p < 0.5$).

H2: The demand and supply environment has a positive effect on supply chain performance. This hypothesis is supported by a standard regression weight of 0.48 ($p < 0.5$).

H3: The ERP System has a positive effect on supply chain performance. This hypothesis is supported by a standard regression weight of 0.49 ($p < 0.5$).

Conclusions

This research focused on testing the factors of supply chain performance and utilization of the ERP system through a demand and supply environment based on the hypotheses set forth in H1, H2, and H3. Results from analysis of 234 small-size, medium-size, and large-size enterprises (illustrated in Figure 2) show that the operational factors of the supply chain must also consider the demand and the environment of supply. Each department uses information from ERP system in coordination with information about the demand and supply environment. Therefore, the organization will be able to improve the performance of the supply chain of the frozen food industry in Thailand by 24% (Ince et al., 2013).

Discussion

The result indicates that information about the demand and supply environment, which is utilized in the ERP system, affects supply chain performance, and therefore, provides a competitive advantage to the Thailand frozen food industry (Tonsakun-aree, Juturat, & Kuntonbutr, 2020). This information can be used for supply chain performance enhancement, starting from the preparation of sufficient raw materials. Further, it can save in manufacturing costs for production and services, and improve delivery time and performance (Ince et al., 2013). This can increase overall efficiency and create positive business collaboration opportunities among entities in the frozen food industry in Thailand. The frozen food industry in Thailand must accelerate the development of processes within the supply chain. By collecting data from work processes in various departments, it helps organizational resource planning for efficiency

and information of each process. It can be used as an important database to support decision-making for the efficient operation of the quality of the interjection chain. Therefore, the information of the demand and supply environment in the ERP system of each industry can increase the supply chain performance. This confirms the resource-based view (RBV) theory regarding the use of resources of an organization in four areas: valuable, rare, inimitable, and non-substitutable (J. Barney, 1991). Thus, all parties concerned must be able to extract information from the demand and supply of the environment, as well as analyze and synthesize in order to make the best use of the information.

Suggestions:

This result of this research indicates that, the demand and supply environment in the ERP system affects the efficiency of the supply chain and creates competitive advantages, especially for the frozen food industry in Thailand. ERP includes all components of the communication within the organization and enables each subdivision to share information necessary for effective operation. It also enhances the best decision-making, improves competitive advantage, and increases the value added to the entire supply chain. This is supported by Diabat et al. (2017). Furthermore, the information of the ERP System facilitates the utilization process of the organization's resource planning. The information from the demand and supply environment are applied to improve the resource management effectiveness and increase competitive advantage (Tonsakun-aree, Juturat, & Kuntonbutr, 2021). The recommendation of future research include that the researcher may bring other information and more studies to measure the capacity of each variable to optimize supply chain, starting from the preparation of sufficient raw materials to meet the production requirements process of the stakeholders. The supply chain performance arrangement can also save production and service costs. It can improve delivery times and efficiency (Ince et al., 2013)), and create positive business cooperation opportunities with agencies in the frozen food industry in Thailand. If the new research leads to the competitive advantage of other industries, then one would want to apply this concept for further operation and analysis of related situations.

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