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Supply Chain Logistics Integration Performance: The Case of the Philippine Processed Food Industry

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Abstract: The relationship between logistics integration competencies of Philippine food firms with their supply chain performance is explored in this research using the 21st Century Logistics framework developed by Michigan State University's Global Logistics Research Team. The results reveal three clusters of logistics competencies attained by Philippine food packaging firms as a result of the logistics capabilities they exhibited. It also shows that respondent Philippine food packaging firms have high levels of logistics competencies compared to international benchmarks. Two logistics integration competencies were found to be significantly associated with firm supply chain performance.

Keywords: Supply Chain 2000; Supply Chain Performance; Logistics Integration; Logistics Competencies; Logistics Framework; Philippine Food Packaging; Supply Chain Metrics; Logistics Capabilities; Relationship Integration; Supply Integration; Segmental Focus.

I. INTRODUCTION

Logistics integration is a source of competitive advantage that leads towards superior Supply Chain performance. The Council of Logistics Management (Bowers ox et al. 1999) defines logistics as follows: Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements.

In the Philippines, there are no empirical studies that specifically measures logistics integration performance of local firms, much less the relationship between logistics integration and firm supply chain performance. This is unfortunate due to the fact that the Philippine food processing industry is a multi-billion pesos industry. It is now a major source of employment, investments and output for the Philippine economy Agri-Food Trade Service of Canada 2003).

The primary objective of the study is to assess and determine the influence of logistics integration competencies from the Supply Chain 2000 framework on supply chain performance of Philippine food processing firms. However, the study also focused on two specific objectives. First, the research aims to find out if there is empirical support to Supply Chain 2000 framework by determining whether six logistics integration competencies can be derived from the logistics capabilities of Philippine food packaging firms. Second, the research identifies logistics competencies that significantly affect Philippine food packaging firm's performance.

II. RESEARCH METHODOLOGY

This chapter discussed the research method used, the population and the sample size and the sampling technique, the description of the respondents, the research instrumentation, the data-gathering procedure and the statistical tool to treat the data gathered.

The standardized questionnaire developed by the Global Logistics Research Team in their Supply Chain 2000 framework, was used in this Philippine study. It is divided into three sections. Data derived from the questionnaire are based on responses of the key personnel handling logistics functions of the respondent firms.

The first section is composed of 106 items in which the questions required respondents to indicate agreement with statements related to specific logistical activities based on a five-point scale where 1= Strongly Disagree and 5 = Strongly Agree. This section basically assessed the level of logistics competencies of respondent firms. This meant that the scores that were provided on each of the variables were summed up to create scores for the capabilities and integration competencies used in the research.

The second section of the questionnaire contains questions regarding logistics strategy of respondent firms. The third section of the questionnaire contains the thirteen key performance variables that represent performance achieved from both an individual firm and a supply chain logistics perspective. Items regarding logistical performance used a five-point scale to determine the respondent's perception of performance relative to competitors, with 1= worse than competitors and 5= better than competitors.

To prevent any bias resulting from perceptually ambiguous statements, the questionnaire was provided with an attached page that listed definitions of these terminologies. This is an attempt by the author to address the issue of different cross-cultural definitions.

In assessing the logistics integration competencies of Philippine food processing firms, the researcher attempted to identify the key industry players that belong to the classification of food packaging firms defined by the Philippine National Statistics Office (NSO). These are the

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following classifications: Cereal preparations; Meat preparations; Fish and marine products; Dairy products and eggs; Processed fruits and vegetables; Non-alcoholic beverages; Coffee, cocoa and tea; and other food commodities such as sugar products, sauces and condiments and cooking oil.

Choosing a sample that conforms to the above criterion necessitated the use of a census of key industry players for each of the above-mentioned classifications. Purposive sampling was done to identify the key logistics and supply chain executives as respondents of each of the firms in the census.

Based on the compiled list of the Agriculture and Agri-Trade Services Canada and the Bureau of Export Trade Promotion of the Philippine Department of Trade and Industry, a total of eighty-two (82) respondent firms were identified as respondents. Actual respondents consist of logistics executives from each of these firms.

Logistics executives are those that directly handle the logistics and supply chain operations of the firms from the acquisition of raw materials to the transport of the products from factory to end-user. The questionnaire was distributed and retrieved by the researcher through special arrangement with a local courier company.

From the above sample size, a total of 82 validated responses from nineteen respondent firms were received. There was a certain degree of difficulty in retrieving all the questionnaires considering the hectic schedules of respondents and their hesitancy to divulge particularly sensitive information about their operations. Nevertheless, an examination of the retrieved questionnaires reveals that these cut across all aspects of the firms' operations.

The main part of the questionnaire was subjected to two different statistical treatments. First, to determine whether the six universal competencies portrayed in the Supply Chain 2000 framework are supported by the actual logistics capabilities of Philippine food processing firms, a Principal Components Analysis (PCA) was done. To validate the result of the PCA, split half sampling technique was used.

The second statistical treatment used is Step-wise Multiple Regression Analyses of the independent variables on measures of firm performance. This comprised thirteen different sets of multiple regression analyses that showed the relationships between supply chain logistics competencies and individual measures of firm performance. All tests of significance were set at 0.05%.

III. RESULTS AND DISCUSSION

The first research question of the study aims to determine whether the logistics capabilities defined in the Supply Chain 2000 framework statistically represent the concepts of logistics integration competencies of Philippine food packaging firms. To address this question, Principal Components Analysis (PCA) was used to determine the unidimensional characteristics of each component (six integrative competencies).

Table 1 shows the components derived from the Principal Components Analysis and their correlations to the variables. The component matrix was rotated using Varimax Rotation Method with Kaiser Normalization.

Table 1 reveals that after Varimax Rotation three principal components were extracted from the PCA. The bold values in the table indicate the principal component scores of each variable, which suggests the unidimensionality of each of the three components. To further validate the result of the PCA, the researcher ran another PCA using a split half sample. The results were the same as the original PCA using all cases.

The results of the Principal Components Analysis revealed that in the case of Philippine food packaging firms, their logistics capabilities do not represent the concepts of six integrative logistics competencies defined in the Supply Chain 2000 framework. It is surmised from the table that instead of six competencies, the twenty-five capabilities make up only three logistics integration competencies in the Philippine setting, which composition is still to be defined.

The same results show that the first cluster of capabilities include Compliance, Strategic Alignment, Guidelines, Financial Impact, Segmental Focus, Internal Communication, Comprehensive Metrics, Collaborative Forecasting, and Responsiveness.

The second cluster includes Gain/Risk Sharing, Financial Linkage, Operational Fusion, Information Sharing, Functional Assessment, Supplier Management, Role Specificity, Simplification, and Structural Adaptation.
The third cluster formed was Standardization, Relevancy, Cross Functional Unification, Total Cost Methodology, Connectivity, Information Management, and Flexibility.
This inconsistency with the results of the survey from that of the Supply Chain 2000 framework suggests that the three clusters formed make up logistics competencies which may be related to each other more than that shown in previous studies using the framework. These relationships can further be validated in future studies.

The second research question of the study aims to determine the level of integrative logistics competencies of Philippine food packaging firms. Table 2 shows the specific scores of each of the 19 respondent firms in terms of the level of their logistics competencies.

From Table 2, it can be surmised that the logistics integration competency which respondent firms rate highest is Internal Integration. This refers to the competency of linking internally performed work into a seamless process to support customer requirements. On the other hand, the logistics integration competency which is rated lowest is that of Material/Service Supplier Integration, This is the competency of linking externally performed work into a seamless congruency with external processes.

Multiple Regression Analysis was used to address the third research question. This statistical technique was used to determine the relative influence of a combination of variables on a single dependent variable. In the case of the

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Supply Chain 2000 framework, the researcher sought to examine the relationship between the six logistics integration competencies on 13 metrics of perceived logistics performance.

Table 3 lists only the statistically significant R^2 and Beta values (coefficients), as well as the significance values ($p \leq .05$), for each performance measure as it relates to the six integrative logistics competencies.

The same table shows that Relationship Integration is a significant predictor of three out of 13 individual performance measures. It emerged as the most dominant logistics integration competency in terms of influencing individual performance variables.

It is observed from the table that Measurement Integration is positively associated with Responsiveness to Key Customers. On the other hand, Customer Integration is negatively associated with the same performance metric. Technology and Planning Integration is also negatively associated with Low Logistics Cost.

Blank cells in Table 3do not indicate any significant relationship. This suggests that no significant association can be found between Delivery Speed, Delivery Dependability, Order Fill Capacity, Order Flexibility, Delivery Time Flexibility, Advanced Shipment Notification, Customer Satisfaction, and Information Systems Support with any of the six logistics integration competencies.

However, in the case of logistics integration competencies that do not exhibit statistically significant relationships with measures of firm performance, there may be two explanations for it. The first is that the competency does not really influence that particular measure of firm supply chain performance or, a second and most likely explanation is that the competency is not a differentiator on that particular aspect of the firm's performance.

Such a situation would result if majority of the respondents reported similar index scores for a particular logistics integration competency. If this is the case, then it is interpreted that the specific logistics competency is a qualifier with respect to that performance measure and that majority of the respondent firms had approximately the same level of achievement.

In the case of the negative associations of certain logistics integration competencies on individual performance variables, this should not be hastily interpreted to mean that these competencies negatively influence firm performance. Previous studies (Bowersox, et al. 1999) have proved that a more in-depth analysis indicated these competencies individually have a slight positive impact on firm performance.

When combined with another dominant logistics integration competency, multiple regression frequently assigns a negative influence to a relatively less important competency. Perhaps a more appropriate interpretation of the negative beta coefficient is that the logistics integration competency has a relatively minor but positive influence on the performance measure.

Relationship Integration, which came out as the most influential of all logistics integration competencies in the study is defined as the competency of developing and maintaining a shared mental framework with customers and suppliers regarding inter-enterprise dependency and principles of collaboration. It has a positive influence on three performance variables namely, Product Flexibility, Low Logistics Cost, and Inventory Turns.

IV. CONCLUSIONS

The findings reveal that the 25 logistics capabilities defined in the Supply Chain 2000 Model only statistically represent three concepts or components of logistics integration competencies in the case of Philippine food packaging firms. However, this finding to a certain degree, cannot be substantiated

The results of the study showed that the logistics integration capabilities of Philippine food packaging firms offer another dimension of the original framework in terms of the number of clusters of logistics integration competencies. Further research should be conducted in line with this finding. However, since the study is limited to Philippine food packaging firms, it is also important to consider expanding the scope to other industries to validate the model.

The high level of logistics integration competencies exhibited by Philippine food packaging firms suggests that they may have adopted international standards and practices of logistics excellence. Another explanation for the high scores could also be attributed to the fact that a sizable number of the respondents firms are subsidiaries of well-established global food firms.

Two logistics integration competencies were found to be positively associated with firm performance namely, Measurement Integration and Relationship Integration. However, the most dominantly influential logistics integration competency is Relationship Integration. This means that Philippine food packaging firms recognize this competency as the most critical competency associated with firm performance.

Attaining this high level of competency requires companies to develop and maintain inter-enterprise dependency with customers and suppliers. This requires willingness on the part of the supply chain partners to create structures, frameworks, and metrics that enable and encourage cross-organizational behavior. This shows that Philippine food packaging firms appreciate the value of establishing inter-firm relationships with both customers and suppliers in the area of logistics. A plausible reason for this is the underlying structure of Philippine business culture which is anchored on the almost familial relationship of firms with each other.

Relationship Integration is positively associated with Low Logistics Cost (LLC), Inventory Turns (IT), and Product Flexibility (PF). The ability to achieve the lowest total cost of logistics through efficient operations, technology, and/or scale economies characterizes the performance measurement of Low Logistics Cost.

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Inventory turns (IT) is a performance measure associated with asset management. Relationship Integration logistics competency is positively associated with inventory turns, which is defined as "cost of goods sold divided by average inventory investment within a time period." Management can use this result to justify increasing inter-organizational collaboration with suppliers and customers.

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BIOGRAPHY

Dr. Randolf Von N. Salindo completed his degree in Agribusiness Management and Master of Business Administration from Silliman University in the Philippines. He took his Doctor of Business Administration from Ateneo de Davao University. He has taught in various private and state universities in the Philippines. He also has extensive experience in the industry as a Business Development Manager in Thailand for two years and as a Marketing Manager in the United Arab Emirates for more than four years. Currently, he is the Dean of the College of Administrative and Financial Sciences at AMA International University-Bahrain where he handles Management and Production Operations courses.

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Table 1: Rotated Component Matrix of the Principal Components Analysis

	Component		
	1	2	3
Compliance	.849	.186	.221
Strategic Alignment	.788	.235	.314
Guidelines	.771	.443	
Financial Impact	.699	.471	.323
Segmental Focus	.694	.319	.509
Internal Communication	.671	.245	.455
Comprehensive Metrics	.623	.427	.411
Collaborative Forecasting	.557	.510	.376
Responsiveness	.556	.445	.393
Gain/Risk Sharing		.811	.306
Financial Linkage	.559	.721	
Operational Fusion	.334	.707	.258
Information Sharing	.332	.699	.405
Functional Assessment	.443	.674	.213
Supplier Management	.402	.579	.466
Role Specificity	.447	.573	.360
Simplification	.366	.556	.336
Structural Adapt	.413	.455	.394
Standard	.162	.266	.816
Relevancy	.198	.340	.760
Cross Functional Unification	.304	.145	.733
Total Cost Methodology	.503	.228	.585
Connectivity	.531	.487	.548
Information Management	.241	.525	.539
Flexibility	.528	.378	.530

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 8 iterations.

Table 2: Level of Logistics Competencies of Respondent Firms

FIRM	Customer Integration	Internal Integration	Material/ Service Supplier Integration	Technology and Planning Integration	Measurement Integration	Relationship Integration
1	68.63	86.63	62.13	70.50	69.88	67.50
2	57.00	77.80	44.20	54.50	62.40	43.90
3	64.33	82.00	52.67	52.00	61.00	58.00
4	70.00	86.22	66.22	68.56	68.67	67.22
5	65.60	85.00	64.60	69.40	65.80	68.00
6	69.75	86.00	63.50	67.50	66.25	67.75
7	59.00	69.00	56.00	56.00	48.00	60.00
8	70.00	96.00	77.00	72.00	74.00	71.00
9	71.10	89.40	70.60	70.60	70.40	70.40
10	50.50	64.50	50.00	43.50	47.50	47.50
11	62.67	84.33	56.33	59.00	62.67	63.67
12	67.00	81.00	68.00	65.50	65.00	63.50
13	74.00	93.00	73.00	73.00	70.00	71.00
14	74.00	92.00	72.00	93.00	75.00	68.50
15	65.00	85.00	67.00	68.00	66.00	69.00
16	72.00	90.00	71.33	71.33	74.33	71.00
17	64.50	80.67	64.17	63.33	65.50	66.50
18	60.80	80.20	60.20	64.40	60.40	60.60
19	68.17	84.33	63.00	66.17	66.83	64.17
MEAN	66.00	83.85	63.26	65.70	65.24	64.17

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Table 3: Regression analyses relating logistics integration competencies to firm performance

	ROA	PF	LLC	DS	DD	RKC	OFC	OF	DTF	ASN	IT	CS	ISS
Customer Integration						-.54							
Internal Integration													
Material/Service Supplier Integration													
Technology and Planning Integration			-.39										
Measurement Integration						.67							
Relationship Integration		.59	.925								.712		
Significance (1st variable) (2nd variable)		.037	.024 .000			.044 .007					.010		
R^2	.04	.63	.27	-.02	.05	.10	.01	.17	.08	.04	.10	.09	.01

Notes:
1. Cell values represent standardized beta coefficients and indicate the statistically significant relative influence of that capability variable on the performance measure.
2. All R2 values are significant at $p \leq .05$

Legend:

ROA- Return on Assets
IT- Inventory Turns
PF- Product Flexibility
CS-Customer Satisfaction
LLC- Low Logistics Cost
ISS- Information Systems Support
DTF- Delivery Time Flexibility
RKC- Responsiveness to Key Customers
OFC- Order Fill Capacity
OF – Order Flexibility
DS- Delivery Speed
DD- Delivery Dependability
ASN- Advanced Shipment Notification

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