Affect of Supply Chain Strategic Fit on Logistics Outsourcing Performance

(Draft)

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Abstract

This study is to examine the effect of relationships for the product characteristics. Outsourced product is categorized into functional and innovative. Logistics strategy for each categorized products should be response into efficient or market responsive supply chain strategy. The research model is developed using six hypotheses. The study is examined empirically, using ANOVA, regression analysis. The results show that the importance on efficient supply chain strategy fit for functional products. And, efficient supply chain strategy is suitable for cost performance. Market responsive strategy is good for quality performance. To get higher logistics outsourcing performance, the strategy should be depended on their products' characteristics.

Keywords : Product type, Supply Chain Strategy, Outsourcing, SCM match and performance

1. INTRODUCTION

A supply chain is a system, a system of processes spanning multiple departments, firms, and countries. The business strategy of a firm specifies the basis for its competitive advantage, or, what the firm should do especially well. For example, three generic business strategies are cost, differentiation, and focus (Porter, 1998). Logistics outsourcing market, in particular, is growing due to the needs to save cost in subsequent areas, the pursuit of economy of scale and specialization of logistics companies. In reality, however, third-party logistics (3PL) specialists need distinct outsourcing strategies for different industrial and product characteristics as each manufacturer employs different supply network strategies according to their industrial and product characteristics.

Manufacturers establish appropriate supply network strategies and systems by considering the characteristics of products that they produce from product planning stage so that they can construct distinguished supply network management systems. Supply network strategies reasonably in terms of efficiency for cost-saving and market-response strategies to respond to the uncertainties of product demand contributes to improving companies' performances (Hayes and Weelwright, 1979; Fisher, 1997; Pagh and Cooper's, 1998; Lee, 2002; Erick, Jan, 2007). Manufacturers pursue efficiency of supply network systems according to their product characteristics and supply network strategies. For example, Dell uses direct sale system to gain competitiveness, while Zara reduces lead time and utilizes reserve facilities at logistics centers. However, logistics companies that outsource shippers' logistics are partners that must collaborate with shippers in terms of logistics and should be able to comprehend shippers' product characteristics to employ suitable supply network strategies

for market competitiveness. In fact, however, many of these companies are not making attempts to make systemized approaches. Most previous studies on the partnerships between shippers and logistics companies have been limited to suggesting different types of logistics services in terms of strategies (Pagh and Cooper's, 1998; Anu H Bask, 2001) or analyzing the success factors and performances of existing partnerships. Not many substantial studies have been conducted on the suitability of supply network strategies based on the understanding of shippers' products. Thus, this study was conducted to apply the compatibility between product characteristics and supply network strategies from the field of supply network management to logistics outsourcing for a substantial analysis. The performance of logistics outsourcing is influenced by various elements, such as the capacities and trust relations of logistics companies (Knemeyer and Murphy, 2004). Some logistics companies have poor outsourcing performances even through have outstanding management capacities. Thus, it would be essential to analyze the impact of the compatibility between product characteristics and supply network strategies on logistics outsourcing performances as much as to analyze the factors that influence logistics outsourcing performances. The purpose of this study was: first, to substantially identify the importance of choosing the right supply network strategy for products in logistics outsourcing. Second, it was to substantially identify the characteristics of supply network strategies and their impact on logistics outsourcing performances. Third, it was to substantially identify the difference in logistics outsourcing performances according to the compatibility between product characteristics and supply network strategies.

This study researched literature to list the factors of logistics performances and added

Fisher's standards on classifying products and supply network strategies. These factors were reviewed by logistics specialists and experts to prepare survey questionnaires that were used to survey shippers and logistics specialists. This study consists of the following: Chapter 2 discusses the theoretical background of supply network strategies according to product characteristics. Chapter 3 establishes a research model and hypotheses on the performances of logistics outsourcing according to product characteristics and supply network strategies. Chapter 4 defines the variables of the research model and the characteristics of measurements and samples. Chapter 5 verifies the feasibility and reliability of measurements and analyzes the findings of this study. Finally, Chapter 6 summarizes the findings and suggests future research topics and directions.

2. LITERATURE REVIEW

Fisher (1997) suggests that an effective supply chain has to be designed with respect to the product that is going to be supplied through the chain. Products can be either functional or innovative, depending primarily on its demand characteristics. Supply chains on the other hand can be either market-responsive or physically efficient depending on its design in terms of resource strategy, inventory strategy, and overall objectives.

Products that are innovative are characterized by variation in demand and by short life cycles, they should therefore be transformed through a responsive supply chain that has extra capacity, the capability for market information processing, and that is more flexible. On the other hand, a steady demand pattern, high volumes and long product life cycles

characterize products that are functional. A physically efficient supply chain that focuses on cost minimization and high utilization of resources should handle this kind of product. The other two combinations are assumed to create mismatches between supply chain and products.

Hayes and Weelwright(1979) developed the product-process matrix, which was designed to show the trade-offs in operations and marketing by linking product plans and process choices.

Lummus, Vokurka, Duclos(2006) revised the Product-process matrix, developed by Hayes and Wheelwright in 1979 was based on traditional trade-offs evident in a single manufacturing facility environment. The new model incorporate the supply chain perspective as the environment has changed significantly – advanced technology, more product customization.

Lee(2002) further defined the characteristics of functional versus innovative products. Functional products have low demand uncertainties, stable demand, long product life, low product variety, higher volume per stock keeoing unit(SKU). Innovative products have high demand uncertainties, variable demand, short selling seasons, high product variety, low volume per SKU.

The supply side of product is categorized ‘stable’ and ‘evolving’ supply process as to the manufacturing process and underlying technology. Lee defines four supply chain strategies to meet product demand. Efficient supply chain use scale economics and optimize capacity and distribution utilization. Risk-hedging supply chains use strategies to pool inventory and

other resources to avoid supply disruption. Responsive supply chains have strategies that are responsive and flexible and use build-to-order and mass customization processes. Agile supply chains utilize strategies to be responsive and flexible but also pool inventory or capacity resources to meet unpredictable demand with minimal disruptions.

Waller and Dabholkar(2000) addressed that supply chain strategies mostly relied on the product characteristics in tow aspects – postponement and product customization. This research explored the relationship between the two topics, but not so clear about how to design an effective supply chain or selecting suitable strategy for supply chain.

Pagh and Cooper(1998) proposed a matrix framework for identifying certain strategy types of supply chain with focusing on the topics of postponement and speculation separately. Huang, Uppal, Shi(2002) is to highlight the importance of the intermediate or hybrid situation of both product category and supply chain, which results into the concepts of hybrid product and hybrid supply chain, which is extended Pagh and Cooper(1998) research.

Kaipia and Holmstro¨m(2007) offer a solution to differentiate supply chain planning for products with different demand features and in different life-cycle phases. This research widens Fisher's supply chain selection framework to consider the aspects of planning. In this study alternative planning approaches were identified and a procedure for their selection is presented.

A Supply Chain is composed of trading partners that are interconnected with financial, information, and product/service flows. Effective management of these flows requires creating synergistic relationships between the supply and distribution partners with the

objective of maximizing customer value and providing a profit for each supply chain member. However, often there is not an effective control mechanism to coordinate the actions of the individual supply chain members by means of attemping to optimize the part rather than whole supply chain system.

Coordination is the essence of supply chain management as evidenced by some of the definitions and perspectives of supply chain management listed in Table XX.

According to the CSCMP(Council of Supply Chain Management Professional), a professional association that developed a definition in 2004, Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers.

Arshinder and Deshmukh (2008) classify the literature on supply chain coordination as follows: Role of coordination in SC and various models, Coordination across different functions and at different, interfaces of SC and Coordination Mechanism. They classify the coordination mechanism with Contract, Information Technology, Information Sharing, Joint decision making.

- Supply Chain Contract: Supply Chain members coordinate by using contracts for better management of supplier–buyer relationship and risk management. The contracts specify the parameters (like quantity, price, time and quality) within which a buyer places orders and a supplier fulfills them. The objectives of SC contracts are: to increase

the total SC profit, to reduce overstock/understock costs and to share the risks among. There are a number of extensions to buyback contracts are presented in the literature like two period supply contract model for decentralized assembly system (Zou et al., 2008) and flexible returns policies in three-level SC (Ding and Chen, 2008) to fully coordinate SC members.

- Information Technology: IT is used to improve inter-organizational coordination (McAfee, 2002; Sanders, 2008) and in turn, inter-organizational coordination has been shown to have a positive impact on select firm performance measures, such as customer service, lead time and production costs (Vickery et al., 2003).

- Information Sharing: The SC members coordinate by sharing information regarding demand, orders, inventory, POS data, etc. Timely demand information or advanced commitments from downstream customers helps in reducing the inventory costs by offering price discounts and this information can be a substitute for lead time and inventory (Reddy and Rajendran, 2005).

- Joint decision making : A coherent decision making helps in resolving conflicts among SC members and in exceptions handling in case of any future uncertainty. Collaborative Planning, Forecasting and Replenishment (CPFR) is a collaboration initiative where two or more parties in the SC jointly plan a number of promotional activities and work out synchronized forecasts, on the basis of which the production and replenishment processes are determined (Larsen et al., 2003).

Narasimhan and Kim(2002) consider three integration levels-a company's integration with

suppliers, internal integration across the supply chain, and a company's integration with customers-for classifying the type of supply chain integration strategy pursued by a firm. To measure these three integration levels, a total of 21 items were used

- Company's integration with suppliers

Information exchange with suppliers through information technology

The level of strategic partnership with suppliers

The participation level of suppliers in the design stage

The participation level of suppliers in the process of procurement and production

The establishment of quick ordering system

Stable procurement through network

- Internal integration across the supply chain

Data integration among internal functions through information network

System-wide information system integration among internal functions

Real-time searching of the level of inventory

Real-time searching of logistics-related operating data

Data integration in production process

Integrative inventory management

The construction of system-wide interaction system between production and sales

The utilization of periodic interdepartmental meetings among internal function

- Company's integration with customers

Follow-up with customers for feedback

The level of computerization for customer ordering

The level of organic linkage with customers through information network

The level of sharing on market information

The agility of ordering process

The frequency of periodical contacts with customers

The level of communication with customers

- Firm performance

Sales growth and market share growth

The growth ratio of the current level to three years ago

Profitability

Return on investment, return on assets, revenue growth, financial liquidity, and net profit

Silveira and Cagliano(2006) is to study that dynamic networks with innovative products may benefit from multilateral interorganizational information system, stable networks with

functional products may benefit from dyadic interorganizational information system.

According to Lehtonen (2004), the success of the relationship is based on many variables for instance, two-way information-sharing, joint problem solving, the partners' ability to meet performance expectations, clearly defined and mutually-agreed goals, and mutual involvement in relationship development and planning

Modeling the logistics outsourcing relationship variables to enhance shippers' productivity and competitiveness in logistical supply chain(M.N. Qureshi, Dinesh Kumar and Pradeep Kumar)

Qureshi, D. Kumar and P. Kumar(2007) are to model the key variables of logistics outsourcing relationship between shippers and logistics service providers (LSPs) and to study their influence on productivity and competitiveness of the shipper company. By using the enablers such as trust or commitment, direct assistance, long term contract, evaluation of supplier performance, practices of TQM and JIT to add distinctive values, and top management support.

Ellram(1995) provides the perceptions of both buyers and suppliers simultaneously on the impetus for entering the partnerships, as well as the key success and failure factors in partnering relationships.

Factors in establishing and maintaining partnerships

- Two-way information sharing
- Top management support

- Shared Goals
- Early communication to suppliers of specification changes, new products
- Supplier and distinctive value
- Flexibility in agreement
- Total quality management initiative
- Training of buyers(sales personnel) in partnering philosophies/methods
- Site visits to supplier
- Multiple relationships/points of contacts between buying and supplying firms
- Sharing examples of success with others
- Ongoing relationships between top levels of buying and supplying firms
- Rewards/recognition for progress
- Personal relationships
- Compatible corporate cultures
- Establishing a task force
- JIT initiatives

Cooper et al. (1997) identified the drivers or managerial levers/variables by which the business processes are integrated and managed across a supply network for successful SCM. They called such variables ''management components'': network structure, planning and control methods, work flow/activity structure, organizational structure, product flow facility structure, product structure, communication and information flow facility structure, management methods, power and leadership structure, risk and reward structure, and culture and attitude.

Power, Sohal, Rahman(2001) analyses the factors critical for successful agile organizations in managing their supply chains, provide the finding that "More agile" companies can be characterized as more customer focused with the combination of "soft" and "hard" methodologies.

Independent variables

- Participative management style – 6 variables(encourage change and implement a culture of trust, degree of unity, champion of change to drive, pursue continuous improvement rather than reacting to crisis, ideas from production operators are actively used in assisting management, top-down and bottom-up communication process)
- Computer-based technologies – 6 variables(CAD, CAM, CNC-computer numerically controlled, LAN, EDI, CIM)
- Resource management – 4 variables(material management and warehousing,

production planning and control, warehousing and materials management, production planning and control)

- Continuous improvement enablers – 3 variables(FMC-flexible manufacturing cells, TQM, VAM-value adding management)

- Supplier relations – 3 variables(work with us in product development, to improve each other's processes, an system for measuring the quality of the materials)

- Just-in-time methodology - 2 variables(contribution to improve factory operations, contribution to competitive position)

- Technology utilization - 2 variables(manufacturing technology for our need and competitiveness, manufacturing technology to its maximum potential)

Dependent variables

- Customer satisfaction

- Average process changeover time

- Productivity

- Delivery in full on time

- Relative technological competitiveness

- Ratio of annual sales to average total stock

- Process technology

- Ability to develop new products
- Production innovation

Sheu, Yen, Chae(2006) identify the social and technical factors contributing to successful supplier-retailer collaboration, by proposing the model of relationship on these variables with 5 research positions.

Business Relationship

- Interdependence : Degree of dependence on this relationship regarding profits and sales volume; availability of alternatives suppliers
- Duration/stability : supply chain employee; not significant
- Trust : benefit/risk sharing; partners' reliability and benevolence

Long-term orientation

- Resource investment : updating the inventory system
- Top management commitment and support : regular meeting between each Top management

Supply Chain architecture

- Communication and information sharing(amount, content) : formal/informal interaction

- Inventory Systems : Order replenishment; degree of computerization
- IT capability : ERP, EDI, POS, E-payment, Barcoding, Automatic replenishment of basic goods, Automatic forecasting for fashion/seasonal goods, ASN
- Supply chain coordination structure : degree to which authority for supply chain related decisions is delegated to corporate

Supplier-retailer collaboration

- Type and number of collaboration projects : forecasting, category management, new product design, promotion campaign, display design, advertising etc.
- Problem solving activities : diverted merchandise, price markdowns, emergency orders, etc.

Supplier-retailer performance

- Inventory level
- Fill rate
- Percentage of returned goods

Moberg, Cutler, Gross, Speh(2002) identify potential antecedents of information exchange, with a conceptual model proposing the relationship between six variables and information

exchange. These variables are information technology commitment, information quality, organizational size, commitment to SCM, trust, and relationship commitment.

Danesea, Romanob, Vinelli(2004) provide a theoretical basis to explain the relations between interfirm coordination mechanisms and the characteristics of interdependence among the actors involved in CPFR implementation. the coordination mechanisms that need to be activated to align and synchronize the supply network members call 'liaison device' – liaison positions, task force and standing committees, integrating manager.

D'Amours, Montreuil, Lefrancis, Soumis(1999) address the impact of information sharing between firms of a manufacturing network. The results show that better price-time scheduling performance is achieved as high levels of information on price and capacity are shared by the contractors with the networking firm.

--- In the aspect of organization: coordination mechanism --- knowledge sharing

Social structure of "coopetition" within a multiunit organization: Coordination, Competition, and Intraorganizational Knowledge Sharing, Wenpin Tsai, Organization Science; Mar/Apr 2002

Wenpin Tsai(2002) investigates the effectiveness of coordination mechanisms – formal hierarchical structure and informal lateral relations - on knowledge sharing in intraorganizational networks.

K. Bullington, S Bullington(2005) propose the SCR(supply chain relationship) model to apply results of research on successful families to supply chain management in order to

improve these critical business relationship. This paper compares the six characteristics of successful families to SCR and categorizes the existing literature into theses six characteristics; commitment(trust), good communication patterns, the ability to deal with crises(change), spiritual wellness(principles), time together, appreciation

Frohlich and Westbrook(2001) attempt to test the relationship between supply chain integration and performance. They suggest three groupings of measures; marketplace measures, productivity measures, nonproductivity measures.

- marketplace measures : market share, profitability
- productivity measures : average unit manufacturing cost, delivery lead time
- nonproductivity measures : customer satisfaction, on-time delivery

Fugate, Sahin, Mentzer(2006) are to consolidate the existing disparate research findings on coordination mechanisms from different disciples and explore how practitioners perceive the use of these mechanisms. This study develops the theoretical framework with antecedents and outcomes of coordination mechanisms which classify into three major categories : price, non-price, flow coordination mechanisms.

Price coordination : quantity discounts, two-part tariff, buy-back/returns policy

Non-price coordination: quantity flexibility, allocation rules, promotional allowances,

cooperative advertising, exclusive dealings, exclusive territories

Flow coordination mechanisms : VMI, QR, CPFR, ECR, Postponement

SC orientation : trust, commitment, norms, dependence, organization compatibility, top mgmt support, learning

Performance index :

Buyer performance : desire of quality, low cost, timeliness, visibility, efficient order discrepancy handling

Supply performance : desire of customer business growth, consistency in order, visibility, efficient order discrepancy handling

Alessandra Marasco(2008) attempt to review the status of literature on TPL with the a literature review scheme. TPL development process has been conceived as consisting of a sequence of stages, each of which goes through a number of interactions/activities. The different stages of relationship development are summarized as Build up stage, Execution stage, Institutionalization stage.

- Build up stage : Partner search & selection, Negotiation, Contract design
- Execution stage : Operations planning/organization, Communication/information processing, Coordination, Control/Monitoring,
- Institutionalization stage : Bonding processes relating to technical, social, administrative,

legal issues

Knoppen and Christiaanse(2007) argues that the different bodies of literature each emphasize a different concern. Understanding the interrelation between the different concerns can increase the success of a partnership. The temporal stage of partnering are decision stage, preparation stage, operation stage.

There are many types of interorganizational relationships. Barringer and Harrison(2000) mention six : joint ventures, networks, consortia, alliances, trade associations and interlock directories. Bhatnagar and Viswanathan(2000) report on strategic alliances between manufacturing firms and global LSPs. The strategic alliance is defined " as the one that yield cost benefits to both parties and whereboth parties utilize the competence of the other partner to enhance their competitive position."

Knemeyer, Murphy(2004) study the influence of six key relationship marketing dimensions on a customer's perceptions of their 3PL provider's performance. The findings seem to offer to improve how the partner perceives their performance by coordinating the relationship marketing efforts.

six key relationship marketing dimensions : specific investment, opportunistic behavior, prior satisfaction, 3PL reputation, communication

Single organizational units no longer handle development and manufacturing. Instead,

these tasks are distributed among various companies or among several organizational units within a company.

Fundamental principles of effective logistics networks concern the agility of a company. Agile competitors, are competitors who understand how to remain competitive by means of proactive amassing of knowledge and competency. Automation with broad implementation of information technology supports agility.

Testable hypotheses

To find reasonable ways to improve the performances of logistics outsourcing between shippers and logistics companies, hypotheses were set on two issues based on preceded studies.

- In logistics outsourcing, supply network strategies would be differentiated according to product characteristics.

- In logistics outsourcing, organizations that employ appropriate supply network strategies for each product type would show better performances than others that do not.

Hypothesis 1. Products with functional characteristics would require more efficient supply network strategies in logistics outsourcing.

Hypothesis 2. Products with innovative characteristics would require more market-

responsive supply network strategies in logistics outsourcing.

Hypothesis 3a. Logistics outsourcing costs would have been reduced for companies that selected efficient supply network strategies.

Hypothesis 3b. Logistics outsourcing quality would have been improved for companies that selected market-responsive supply network strategies.

Hypothesis 4. Improved importance of efficient supply network strategies would have positive contributions to logistics outsourcing costs.

Hypothesis 5. Improved importance of market-responsive supply network strategies would have positive contributions to the quality of logistics outsourcing services.

Hypothesis 6. Logistics outsourcing performances would be different for companies that match product characteristics with supply network strategies and others that do not.

3. RESEARCH METHODOLOGY

3.1 Setting Variables for Hypotheses

(1) Product Variables

The survey on product characteristics was based on the seven variables of demand which Fisher (1997) suggested for the classification of functional products and innovative products. The seven variables were average demand estimation error rate, average product defect rate, average product lifespan, average production lead time, average number of products in each

category, average product profit rate, and average discount rate after peak season. These variables were rated on a Likert's scale of one through seven. Survey takers were asked to provide the value that represents the products for which they are commissioned.

(2) Supply Network Strategy Variables

For supply network strategies, the product and supply network strategy compatibility standards of Fisher (1997), Huang, Uppal, and Shi (2002) were adopted as the variables. The survey on supply network strategies were based on the eight variables of efficient supply network strategies and market-responsive supply network strategies that are compatible with select products. The eight variables were minimization of logistics cost, improvement of inventory cycle and minimization of inventories, maximization of average facility operation rate, minimization of lead time without additional logistics cost (lead time considering cost), maximization of promptness for urgent demands, maximization of buffer inventories of major parts or finished goods, maximization of buffer capacities of supply network, and minimization of lead time using various active measures. Survey takers were asked to rate the variables on a Likert's scale of one through seven; one being least important and seven being most important.

(3) Logistics Outsourcing Performance Variables

Preceded studies clearly manifest that performances can greatly vary according to supply

network strategies. The nine variables used by various studies based on the performance variables presented by Erick and Jan (2007) in their substantial study of Fisher's model on the relationship between product characteristics and supply network strategies were used to measure logistics outsourcing performances. Shippers and logistics specialists were asked to assess their logistics outsourcing performances compared to their performances in prior to outsourcing on a Likert's scale of one through seven; one being least improved and seven being most improved. The variables that were used to measure the performances of logistics outsourcing are listed in <Table 1>.

>> *Insert Table 1 here* <<

3.2 Subjects and Resources

Survey takers were logistics coordinators for shippers and logistics outsourcing coordinators for logistics companies. Snowballing technique was used for sampling to reduce problems with representation and minimize errors in predictability and feasibility. Contact information of selected coordinators was received for the survey (Buckles and Ronchetto, 1996). Survey forms were delivered via e-mail, personal visit, or fax and survey period was about a month and a half from mid-June until the end of July in 2009. Among the survey forms that were recollected, incomplete ones were supplemented by contacting the responders individually. Also, each organization was surveyed multiple times if there were multiple products on outsourcing. All 124 copies of survey forms were recollected and 91

of them were finally analyzed as the remaining 33 copies were incomplete.

3.3 Characteristics of Samples

Among the 91 responders, the largest percentage (25.3%) was in the food and beverage industry, but the logistics outsourcing clients were distributed to all industries. The most popular kinds of logistics outsourcing services were transportation (21.6%) and warehousing (19.0%). This shows that transportation and warehousing take the largest part of logistics outsourcing and the services include customs and forwarding, ordering, procuring, and inventory management. Among the companies that were surveyed, 80.2% of them recorded more than KRW 50 billion in sales in 2008 and 73.6% of them had more than 200 employees. Thus, a majority of them were large companies. Also, 69.2% of survey takers were taking charge of logistics and qualified responders for this study. Among the survey takers, 51.6% had more than five years of experience in logistics. By position, 70.3% were team leaders or lower, 28.6% were managers or lower, and 1.1% were executives or higher. Thus, a majority of responders were hands-on employees.

4. SUBSTANTIAL ANALYSIS AND HYPOTHETICAL RESEARCH

4.1 Method and Process of Analysis

For the analysis of resources, SPSS 16.0 was used for exploratory factor analysis, difference analysis, correlation analysis, and regression analysis, and Amos 16.0 was used for

confirmatory factor analysis. The sub-factors of product characteristics, supply network strategies, and logistics outsourcing performances from the theoretical study were examined in terms of reliability and feasibility to derive the research model variables. The following procedures were adopted to verify the research model and the hypotheses and to derive findings:

1. Exploratory factor analysis and confirmatory factor analysis were performed to establish feasibility and reliability for the variables;

2. Difference analysis was performed to analyze the correlation between product characteristics and supply network strategies (hypotheses 1 & 2 verified).

3. Difference analysis and regression analysis were performed to analyze the relativity between supply network strategies and logistics outsourcing performances (hypotheses 3, 4, & 5 verified).

4. Difference analysis was performed to analyze the compatibility between product characteristics and supply network strategies (hypothesis 6 verified).

4.2 Feasibility and Reliability Analysis of Variables

This study used one or more categories of measurements for each item as secondary variables and these categories needed clarification before the analysis. Principal component analysis was used to derive exploratory factors and Orthogonal Rotation of Varimax with Kaiser Normalization was used to improve the condition of answers while

keeping the factors independent.

(1) Measuring Supply Network Strategy Characteristics

The supply network strategy characteristics of this research model include a number of sub-factors, including minimization of cost, minimization of inventories, maximization of operation rate, minimization of lead time considering cost, maximization of promptness, maximization of buffer capacities, and minimization of lead time. In result of exploratory factor analysis, they were classified into two conceptual factors: efficient supply network and market-responsive supply network. This matches the supply network strategy classification of Fisher (1997) or Lee (2002) and manifests that supply network strategies are considered for logistics outsourcing. As shown in <Table 2>, factor loading was above 0.6 for each variable, indicating that there was convergent validity. Commonness was above 0.5 and the overall dispersion was 59.38%. Minimization of lead time considering cost was the only strategy excluded, probably because considering cost and lead time is relevant to both market-responsive and efficient supply network strategies.

>> *Insert Table 2 here* <<

(2) Measuring Logistics Outsourcing Performances

The logistics outsourcing performance measuring part of this research model consists of a number of sub-factors that include sales growth, profit, inventories, logistics cost, shipping accuracy, logistics quality, shipping promptness, customer satisfaction, and expansion of the perimeter of logistics outsourcing. The results of exploratory factor analysis consisted of two conceptual factors and were classified into logistics cost improvement performance and logistics quality improvement performance. These results can be used to analyze the impact of supply network strategies on specific performances of logistics outsourcing. As shown in <Table 3>, factor loading was above 0.6 for each variable, indicating that there was convergent validity. Commonness was above 0.5 and the overall dispersion was 67.90%. Expansion of the perimeter of logistics outsourcing was the only strategy excluded, probably because expansion of logistics perimeter is not directly related to performances, but is a secondary outcome of the performances of logistics services.

>> *Insert Table 3 here* <<

(3) Measuring Product Characteristics

This study adopted the classification standards of Fisher (1997), including demand estimation error rate, product defect rate, product lifespan, lead time, number of products, profit rate, and discount rate, for product characteristics. In result of implementing

exploratory factor analysis to establish validity for all variables, it was found that Fisher's product classification standards are not applied consistently. This means that each industry might define functional products and innovative products differently in reality. There were particularly big gaps in terms of the number of products, and profit rate and discount rate were more affected by each company's policies than they were by product characteristics. Also, the average defect rate (1.84) was too low to be considered due to various improvement efforts and the concept of lead time was unclear considering production or logistics. Thus, these variables were excluded and only demand estimation error rate and product lifespan of Fisher's product characteristics were used to classify products in this study.

4.3 Confirmatory Factor Analysis and Reliability

The results of exploratory factor analysis of supply network strategies and logistics outsourcing performances were verified and analyzed for reliability using confirmatory factor analysis. The optimal condition of each factor was assessed using various fit indexes, including Goodness-of-fit index (GFI $\geq$ 0.9), adjusted goodness-of-fit index (AGFI $\geq$ 0.9), X^2/degree of freedom ($\leq$ 0.2), Root Mean-Square Residual (RMR $\leq$ 0.05), Normal Fit Index (NFI $\geq$ 0.9), and Comparative Fit Index (CFI $\geq$ 0.9). In this process, the significance and value of coefficient were considered to eliminate factors that interfered with compatibility.

(1) Confirmatory Factor Analysis of Supply Network Strategies

<Table 4> shows the results of suitability assessment of confirmatory factor analysis of supply network strategies. Maximization of supply network buffer capacities, which was one of the characteristics of market-responsive supply network strategies in confirmatory factor analysis, was eliminated in result of suitability assessment. It was probably because logistics companies classified this factor as an unattainable strategy as it takes enormous investments to maximize buffer capacities to improve promptness. In result of assessing the overall suitability of the final model, the values were: GFI = 0.96, AGFI = 0.91, X^2/degree of freedom = 1.31, RMR = 0.1, NFI = 0.9, CFI = 0.97, and TLI = 0.95. Also, the t-value of coefficients was significant and the standard coefficient value was above 0.4 and satisfactory. When there are less than 100 samples, TLI (Tucker-Lewis Index) or CFI (Comparative Fit Index) can be used to analyze suitability (Stephen, 2006).

>> *Insert Table 4 here* <<

(2) Confirmatory Factor Analysis of Logistics Outsourcing Performances

<Table 5> shows the results of suitability assessment of confirmatory factor analysis of logistics outsourcing performances. Sales growth was finally eliminated from cost performances. Sales growth is partially related to reducing logistics cost, but it is more

strongly affected by corporate management factors. Therefore, it was eliminated from this study. In result of verifying the overall suitability of the final model, the values were GFI = 0.95, AGFI = 0.90, X^2/degree of freedom = 1.14, RMR = 0.05, NFI = 0.95, and CFI = 0.99. Also, the t-value of coefficients was significant and the standard coefficient value was above 0.4 and satisfactory.

>> *Insert Table 5 here* <<

4.4 Reliability Analysis of Variables

This study used various categories to measure all variables as identical concepts and analyzed internal consistency using Cronbach's α value. In social science, reliability is generally considered high when Cronbach's α is above 0.6 when analyzing a group (Gye Soo Kim, 2007). For the results of analyzing the overall reliability of the final variables, as shown in <Table 6>, Cronbach's α was above 0.6 to satisfy the required level of reliability.

>> *Insert Table 6 here* <<

4.5 Verification of Research Model and Hypotheses

As the feasibility and reliability of variables were verified, the hypotheses of this study's research model were examined using the methods of statistical analysis.

(1) Difference Analysis of Product Characteristics of Logistics Outsourcing and the Importance of Supply Network Strategies

Based on the hypothesis that the importance of select supply network strategy would vary according to product characteristics in logistics outsourcing, product characteristics were classified into functional products and innovative products based on estimated error rate and product lifespan and other products with conflicting characteristics were classified into neutral types. The results of ANOVA on the importance of efficient and market-responsive supply network strategies are as shown in <Table 7> and <Table 8>. In ANOVA of the importance of efficient supply network strategies, it was found that functional products have a higher average (5.773) than innovative products (5.098) and this result was statistically significant ($p < 0.01$). The average of functional products (5.030) was also higher than that of innovative products (4.732) in ANOVA of the importance of market-responsive supply network strategies, but it was not statistically significant ($p > 0.05$). Therefore, Hypothesis 1 was valid, but Hypothesis 2 was not valid. Supply network strategies based on the uncertainties of product demand in supply network management can be applied to logistics outsourcing according to shippers' outsourcing products. In particular, it was substantially indicated that efficient supply network strategies are important for functional products. However, logistics outsourcing facilities do not have clear classification of products and it

would take further improvement to apply Fisher's manufacturer-based standards for product characteristics and supply network strategies to Korea's logistics industry.

>> *Insert Table 7 here* <<

>> *Insert Table 8 here* <<

(2) Hypotheses on the Importance of Supply Network Strategies and Logistics Outsourcing Performances

The results of difference analysis of logistics outsourcing performances according to supply network strategies in logistics outsourcing are as shown in <Table 9>. The average logistics cost of efficient supply network strategies (5.564) was higher than that of market-responsive supply network strategies (5.111), and it was statistically significant ($p < 0.1$). Other cost performance factors, profit and inventories, also showed higher averages with efficient supply network strategies, but it was not statistically significant. In difference analysis of quality performances, it was found that the average values for shipping accuracy, logistics quality, shipping promptness, and customer satisfaction were higher for market-responsive supply network strategies than efficient supply network strategies. However, only the differences in shipping accuracy and shipping promptness were statistically significant ($p < 0.05$). Therefore, Hypothesis 3 on difference analysis of logistics outsourcing performances according to supply network strategies is only partly supported. Although not all

categories were statistically significant, differences in logistics cost for the cost performance section and in shipping accuracy and shipping promptness for the quality performance section were found to be significant performance indexes in reality. The hypothesis on the importance of efficient supply network strategies and logistics outsourcing cost performances showed that the R^2 value is only 0.125 as indicated in <Table 10> and the F value, the ratio of error dispersion and described dispersion, is 2.000 with the significance probability of 0.075. Thus, the regression model was not statistically significant at the significance level of 0.05. In terms of the hypothesis on the importance of market-responsive supply network strategies and logistics outsourcing quality performances, the R^2 value was rather low at 0.237 as shown in <Table 11>, but the suitability of regression model (F value) was 4.348 and the significance probability was 0.000. Thus, the model was statistically significant at the significance level of 0.01. Maximization of operation rate and quality performances of efficient supply network strategies also had a negative correlation in the relationship between standardized regression coefficient and quality performances, whereas buffer inventories and quality performances of market-responsive supply network strategies has a positive correlation ($p < 0.05$). Also, standardized regression coefficient of minimization of lead time and quality performances had a positive correlation ($p < 0.1$). Thus, Hypothesis 4 was not supported and Hypothesis 5 was partly supported. The causality between the importance of supply network strategies and logistics outsourcing performances was not clear, but there were clear differences in some of the major performances indexes (logistics cost, shipping accuracy, and shipping promptness).

A preceded study that the priority of performances may vary according to manufacturers'

supply network strategies (Fisher, 1997; Naylor et al., 1999; Lemming, 2000; Herland et al., 2001; Lee, 2002) seems to be affected by more external variables to be applied to logistics outsourcing. Cost performances of logistics outsourcing are not decided by the efficiency of supply network between shippers and logistics companies, but the prices are decided by market competition or sales strategies. Thus, the cost performance model should be reconsidered. Quality performances, on the other hand, are higher when the importance of market-responsive supply network strategies is more strongly emphasized through procedures and training in logistics outsourcing.

>> *Insert Table 9 here* <<

>> *Insert Table 10 here* <<

>> *Insert Table 11 here* <<

(3) Hypotheses on Product Characteristics, Suitability of Supply Network Strategies, and Logistics Outsourcing Performances

In logistics outsourcing, the results of difference analysis on logistics outsourcing performances according to product characteristics and supply network strategies are shown in <Table 12>. In logistics cost performances, the average suitability of logistics cost (6.071) of groups that matched functional products with efficient supply network strategies was statistically significantly ($p < 0.5$) higher than those of groups that matched functional

products with market-responsive supply network strategies (5.750) or innovative products with efficient supply network strategies (5.286). In terms of shipping accuracy, shipping promptness, and customer satisfaction, the averages of groups that matched innovative products with market-responsive supply network strategies (shipping accuracy: 5.308, shipping promptness: 5.154, customer satisfaction: 4.885) were higher than those of groups that matched innovative products with efficient supply network strategies (shipping accuracy: 4.743, shipping promptness: 4.686, customer satisfaction: 4.629) and lower than those of groups that matched functional products with market-responsive supply network strategies (shipping accuracy: 6.250, shipping promptness: 5.750, customer satisfaction: 5.750). These differences were statistically significant (shipping accuracy: $p < 0.01$, shipping promptness: $p < 0.05$, customer satisfaction: $p < 0.1$). Fisher's model on manufacturers' product characteristics and supply network strategies say that this rarely happens, but using fast and reliable supply network strategies for functional products in logistics outsourcing will definitely improve the quality of services. If cost is not considered, quality performances would be improved by providing logistics services for functional products with low profit margin. In this respect, Hypothesis 6 on difference analysis between logistics outsourcing performances of groups that match product characteristics with supply network strategies and groups that do not was partly supported. In reality, logistics outsourcing services mix efficient supply network strategies and market-responsive supply network strategies and product characteristics change with time. Therefore, groups matching product characteristics with supply network strategies might not show better performances in all categories compared to other groups. However, Fisher's theory on the compatibility between product characteristics and supply network strategies and Erick and

Jan's (2007) substantial study on the compatibility between manufacturers' product characteristics and supply network strategies showed that compatible groups record better performances than incompatible groups in terms of cost, shipping promptness, and shipping accuracy. Thus, it is significant that this study also achieved the same results for logistics cost, shipping accuracy, shipping promptness, and customer satisfaction in logistics outsourcing. In order to improve logistics performances, an important factor in logistics outsourcing, it is necessary to support supply network strategies that match the characteristics of shippers' products.

>> *Insert Table 12 here* <<

5. CONCLUSION

Findings and Suggestions

Logistics outsourcing is established based on consignment contracts between shippers and logistics companies for mutual profitability. As partners, shippers and logistics companies employ various collaborative measures to pursue system improvement and efficiency to save cost and improve services. Manufacturers that have their own logistics services employ the most desirable supply network strategies for their products to execute the logistics, but manufacturers that consign logistics outsourcing services, although they can save cost, are relatively less satisfied by the services provided by logistics companies that pursue economy of scale. Manufacturers intend to establish supply network strategies and

systems that match their products from product planning stage to build distinguished logistics systems. They pursue efficiency to improve their logistics performances, but logistics outsourcing companies hardly make systemized approaches although they are partners required to comprehend shippers' product characteristics and apply reasonable methods to choose the right supply network strategies. Thus, this study substantially analyzed supply network strategies according to product characteristics by applying the theories studied in supply network management to logistics outsourcing. The following summarizes the findings of this study:

First, supply network strategies based on the uncertainties of product demand in supply network management can be applied to logistics outsourcing according to shippers' outsourcing products. In particular, it was indicated that efficient supply network strategies are important for functional products (Hypothesis 1 accepted). Second, in analyzing logistics outsourcing performances according to supply network strategies, efficient supply network strategies showed differences in logistics cost, a factor of cost performances, and market-responsive supply network strategies showed differences in shipping accuracy and shipping promptness, factors of quality performances (Hypothesis 3 partly accepted). Also, the importance of efficiency supply network strategies and the impact on the cost performances of logistics outsourcing were not statistically significant (Hypothesis 4 rejected), while market-responsive supply network strategies and the impact on the quality performances of logistics outsourcing had a negative correlation with maximization of operation rate, a factor of efficiency supply network strategies, and a positive correlation with shipping accuracy and minimization of lead time, factors of

market-responsive supply network strategies (Hypothesis 5 partly accepted). Thus, a preceded study that the priority of performances may vary according to manufacturers' supply network strategies (Fisher, 1997; Naylor et al., 1999; Lemming, 2000; Herland et al., 2001; Lee, 2002) was not completely applied to logistics outsourcing. Third, in logistics outsourcing, performances based on the compatibility between product characteristics and supply network strategies were higher for compatible groups than for incompatible groups in terms of logistics cost, shipping accuracy, shipping promptness, and customer satisfaction (Hypothesis 6 partly accepted). Fisher's theories and substantial studies on product characteristics and supply network strategies were already being applied to logistics outsourcing.

As not many preceded studies examined outsourcing performances of shippers and logistics companies in outsourcing partnerships in relation to product characteristics and supply network strategies, this study was academically significant as its substantial analysis of outsourcing performances considering product characteristics and supply network strategies. The following are the suggestions of this study:

First, this study provides a substantial guide for the mutual collaboration of manufacturers and logistics companies in logistics outsourcing. In particular, it suggests supply network strategies and substantial directives based on shippers' product characteristics for logistics companies to improve the efficiency of their outsourcing services. Logistics companies must maintain collaborative partnerships with shippers. However, cooperation without any understanding of shippers' product characteristics and supply network strategies could not develop into sustainable partnerships. This study would provide logistics companies

with opportunities to prepare for logistics outsourcing procedures that are suitable for different product characteristics and supply network strategies. Second, logistics companies could learn which supply network strategies are needed to propose outsourcing partnerships to shippers. It would be advantageous for them to check various factors that might influence their logistics performances based on the understanding of shippers' product characteristics and supply network strategies to establish compatibility between product characteristics and supply network strategies. Third, shippers would be able to choose logistics outsourcing companies that support supply network strategies and logistics systems that match their product characteristics.

Limitations and Future Study Topics

This study has the following limitations that should be further improved in future studies for more constructive findings: First, product characteristics were classified into functional products and innovative products based on Fisher's numerical classification method, but it was rather unclear to apply to logistics. In future studies, substantially measurable variables should be developed and Fisher's numerical classification method should be reviewed and improved to fit today's market conditions. Also, it would be necessary to develop standards that match the product characteristics of each industry. Second, this study surveyed both shippers and logistics companies in terms of product characteristics, supply network strategies, and logistics outsourcing performances, but it could not compare shippers and their logistics companies to clarify the positions between shippers and logistics

companies. In future studies, shippers and logistics companies should be mutually compared and more samples should be considered to generalize the findings. Third, further studies would be necessary as this study did not consider the differences in performances according to the factors that affect logistics outsourcing performances and the compatibility between product characteristics and supply network strategies. Fourth, the survey for the purpose of this study had to be performed comprehensively, but it relied on lateral measures due to time and methodological restrictions. Thus, the responses were based on responders' past experiences. It is necessary to verify the research model on logistics performances according to products and supply network strategies in logistics outsourcing from a long-term perspective.

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Table 1 Performance Index for Logistics' Outsourcing

Performance Index	Performance measures for logistics' outsourcing	Researchers
Performance and satisfaction	Growth rate	Narasimhan & Kim (2002), Frohlich & Westbrook (2001), Lummus et al. (2008)
	Profit	
	Customer satisfaction	Qureshi et al. (2007), Frohlich & Westbrook (2001), Lummus et al. (2008)
	Enlarge outsourcing	
Cost	Inventory level	Silveira and Caglianco (2006), Frohlich & Westbrook (2001), Lummus et al. (2008)
	Logistics cost	
Quality	Logistics Quality	Knemeyer and Murphy (2004)
	Delivery speed	
	Delivery accuracy	