

The Effects of E-commerce on Supply Chain Structure in Korea Traditional Industries.

Moon, Seongam 1) , Oh, Sejin 2)

1) Dongeui University, Faculty of Distribution Management(samoon@hyomin.donguei.ac.kr)

2) Kangnam University, Faculty of Business Administration(ohsj@kns.kangnam.ac.kr)

Abstract

This study shows how are the effects of electronic commerce on supply chain. We focus on Korea traditional industries, electronic, chemical, steel, automobile, fashion and construction industries.

Considered factors for supply chain structure are the number of echelons, the interdependence between supply chain members, the lead-time of the supply chain and the response point of the supply chain.

Through the survey and interview, we will make some hypothesis and exam those. The goals of this research are as followings.

First, diagnosis the supply chain structure of traditional industries.

Second, analysis the difference between industries' supply chain structures.

Third, define affecting factors of the difference between industries.

Forth, analysis the electronic commerce placement points on each industry's supply chain.

Finally, define the e-commerce types on each supply chain.

This research is not yet launched but till the end of 2000 will be finished.

1. Introduction

Electronic commerce is boomed and changes the traditional supply chain structure radically. Dell(computer provider), for example, removes the intermediaries through the internet selling. IBM also has focused on internet selling. These online selling make the PC supply chain structure more short.

As customer's needs for product and service has higher level and diversified, firms have to satisfy it to survival. To survival in tremendous uncertain environment, firms must use the electronic commerce.

Customer expects the product delivered as soon as possible that is selected conveniently at home and office. This customer expectation makes firms use the electronic commerce on supply chain. Because the competitive advantage relies on overall supply chain structure and all parties of a supply chain cooperate each other for gain the value. Separate activities between supply chain member result in the irrational to the customer, such as delay, noise and so forth.

But the constraint of resource makes EC investment limitation that simultaneous EC launching on all supply chain is difficult or impossible. So firms or supply chains have to begin EC on particular point not over all, and need to enlarge the area of EC step by step.

Therefore, we like to know the EC start point in Korea traditional industries that almost be in beginning stage of EC. We will also define the EC types according to the environment and supplier and buyer relationship to the traditional industries.

This study also will introduce the ideal EC placement points and types to accomplish the overall supply chain performance, and analysis the difference between the ideal and practical EC that gap between the ideal and practice will influence on the supply chain performances.

We premise this study that there are many participants in a supply chain and the goal of these participants is making a profit through the overall supply chain performance improvements. Each member must manage the supply chain activities for the overall effectiveness not for individual profit because individual activities may be stuck in sub-optimization. Now firm compete with following concept that competence between supply chain versus supply chain is more critical to success than that between firm to firm. So many leading companies integrate the whole supply chain into one unit with supply chain management.

To begin with, the factors of supply chain structure are introduced. For the flow management, we applied the constraint theory with response point in supply chain. Finally, we hypothesis about e-commerce placement points and typologies. In this presentation, we ommit general diagnosis about current supply chain structure of traditional industries.

2. Factors of SCS

Because supply chain includes the flows from supplier to customer(but this study focus on the range from manufacture to customer), the related activities to the flows so much that SCS cannot easily be defined. Although discussions on the design of SCS are still not many, the following factors such as the number of echelons, the interdependence between supply chain members, the lead-time of the supply chain and the response point of the supply chain are determinant factors of SCS. Followings will show the importance of the factors in designing the supply chain.

1) Echelon of Supply chain

First of all, the number of echelon is defined as the length of the supply chain between the point of origin to the point of consumption(Hoekstra et al. 1991). The model of the supply chain supply chain by Forrester is described into 5 stages : raw material suppliers, manufacturers, factory warehouse, distributors, and retailers(Forrester 1961). Wikner, Towill & Naim states 4 stages model. They believe that since the factory warehouse is part of the manufacturer, it should not be divided into a separate stage(Wikner et al. 1991).

However, it is necessary to subdivide the supply chain supply chain even further. A great amount of decision making on the flow of goods and information are done by wholesalers and local points but they are not included in typical model stages of Forrester or Wikner et al..

As it was mentioned above, the number of echelon is important because it has a direct effect on supply chain balances such as the Bullwhip effect and the demand amplification effect. It was shown that as the supply chain of the supply chain got longer, delay and the information distortion between the members was greatly increased (Burbidge 1961; Forrester 1961; Towill et al. 1992, 1996; Wikner et al. 1991).

2) Interdependence of the supply chain members

In the design of the SCS, should the raw material supplier or the distributor be internalized? If the distributor is to be externalized, how should their management interdependency be managed? Problems just mentioned are one of the important decisions to be made. These problems could also be called the problem in the relation between the manufacturer and the distributor.

Functions such as order processing, production, distribution, etc. are existent in the relation between the manufacturer and the distributor. In the supply chain, there are times when the manufacturer could have the power position to decide the amount of distribution, or the distributor could be in the position to influence the amount of goods to be manufactured. Generally, in the relation between a manufacturer and the distributor, a contract is formed.

Contracts could be largely classified into behavior based contract and result based contract (Eisenhardt 1989). Eisenhardt(1989) focused in the point of view of the contract efficiency of the relationship between the manufacturer and the distributor. He stated that monitoring, relationship, risk are some of the factors that influence the contract efficiency. According to Lassar & Kerr(1997), products that use differentiation strategy tend to have higher interdependency among the activities between the supply chain members. Thus, the possibility of a behavior based contract occurring is higher than a result based contract in that strategy. However, products that use cost leadership strategy have a higher chance of having independent management among the supply chain members, thus the possibility of a result based contract being made is much higher.

The importance of interdependent management between supply chain members is that many problems of the imbalance of supply and demand are aroused in the supply chain (Lee et al. 1992, 1996). In the explanation of the bullwhip effect in the supply chain by Lee and others, the execution of independent functions by supply chain members caused the imbalance of supply and demand mainly.

3) Lead-time of the Supply chain

To supply the consumer with the product in right place and right time, how smooth should the flow of materials and information between the members of the supply be? This is a very important problem in the SCS. The term lead-time has a very close relation with deciding the type of transportation and the tool of communication, and because of that it has enough interest as a factor in the decision making of the policy in the SCS.

The lead-time of the point of consumption refers to "time it takes for the product or service to be

transferred to the final consumer after the order is made"(Christopher 1992). The lead-time of supply chain refers to the sum of all the lead-time of each of the supply chain members. If it is judged from the time when the raw material is procured and manufacturing is made, it is referred to as Make-to-Order lead-time (MTO). The sum of the lead-time from the point of consumption to the supplier of the raw materials is referred to as the sum of the function of individual members.

Forrester, Wikner, Towill & Nam all emphasized that there are delays to the lead-time. The types of delays include clerical delay, manufacturing lead-time delay, mail delay, requisition delay, transport delay and others. On the other hand, Christopher(1992) subdivided the entire lead-time into planning lead-time(receiving orders, planning, handling delay), resource lead-time(resource planning and purchase, supplier, transport, storage and coroner, assemble order and order picking lead-time), assemble lead-time(stand-by time, handling time, movement time lead-time), and distribution lead-time(delivery preparation time, distribution to customer time). He also emphasized that value-added is created by minimizing the lead-times. Many scholars believe that the lead-time in the supply chain applies directly to time competitiveness and that minimizing the lead-time is an utmost priority in uplifting the competitiveness of the modern corporations.

The lead-time of the supply chain has influences to various supply chain related activities. First of all, a reduction in supply chain lead-time would cause the safety inventory, frequency of order, and the batch size of the order to be reduced. However, transportation costs would be increased. Likewise, in the activities of the supply chain, one variable has a direct relation to another variable and usually they trade-off each other.

4) Response point of supply chain

The structural factor in the supply chain that is designed by the manufacturer is the response point of the supply chain. The starting point of the material response to the final consumer is the response point of the supply chain. According to some scholars defined response point as the point where the push by demand forecasting and the pull by consumer meet (Hoekstra et al. 1991; Jones, Hines, & Rich 1997).

Christopher(1992) also mentioned the response point in his works. He referred the entire time period from the product's raw material supply to the transfer to the consumer as the material lead-time. The amount of time that the customer is willing to wait after making the order is called order cycle time. Christopher believes that since the material lead-time and the order cycle cannot always be the same (hence the appearance of a lead-time gap), the manufacturer must put the product in position within the order cycle by forecasting the demand. This positioning is also called the decision(response) point.

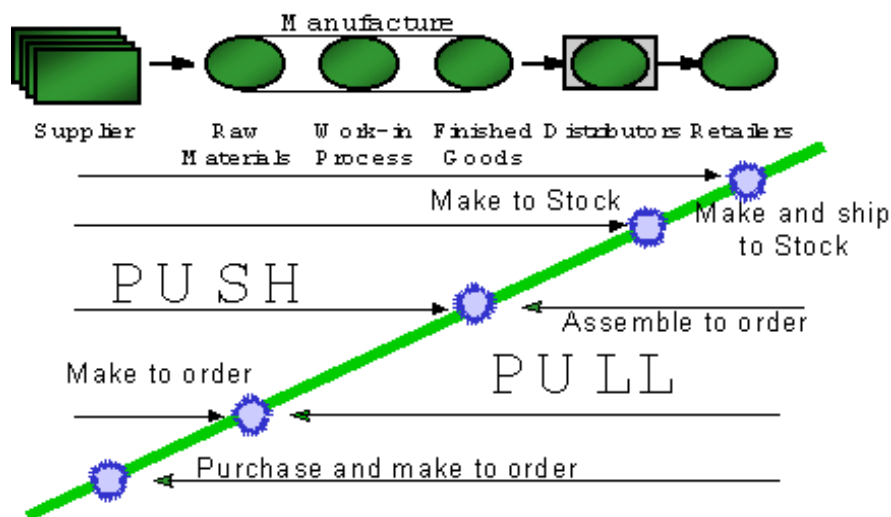
Discussions about response point had been going on in the production management field for some time, with the issue of the inventory location being its main focus. The so called positioning strategy has been considered the core production strategy (Krajewski et al. 1996). Positioning strategy can be divided into make-to-stock strategy, assemble-to-order strategy, and make-to-order strategy. It has been able to maintain the response of the consumer within the production organization and efforts to minimize

inventory has been emphasized but it has not been able to improve the overall level of the supply chain.

Hoekstra & Romme(1992) have subdivided it even further and applied it to the supply chain. As shown in <Figure 1>, response points were divided into 5 types.

1) Make and ship to stock(MSTS) : Product manufactured is in the vicinity of the customer. 2) Make to stock (MTS) : Finished product is stored in as inventory, then it is distributed to the customer. 3) Assemble to order (ATO) : Product is left in process in the manufacturing plant as inventory until a specific customer order is made. It is then assembled as a finished product and delivered to the customer. 4) Make to order (MTO) : Raw materials and parts are stored as inventory until the consumer order is made. It is then manufactured and delivered to the customer. 5) Purchase and make to order (PMTO) : No inventory is kept in the manufacturing plant. When a customer order is received, raw materials are purchased and manufactured. It is then delivered to the consumer.

Fig. 1 Types of response points



Source : Hoeckstra and Romme, *Integral Logistic Structure*, Industrial Press, 1992.

The followings are the reasons why the response point is so significant to the supply chain: 1) Response point is divided into order based activities and forecast based activities. 2) It is the point where independent demand changes to dependent demand. 3) In the flow of products, it is an important location to store inventory. 4) The decision making characteristics alters and from the point of response, the upstream section receives pressure on inventory while the downstream section receives pressure from insufficient orders.

Therefore, in the upstream section, the main decision making is in the planning whereas in the downstream section, the main decision making is the management of orders. However, in the supply chain there is a difference between the response point and the location of the inventory. In the supply chain, the response point does not signify the location of the main inventory. The reason is because in the response point not too many inventory is necessary, and a secondary structure could be constructed to store inventory in the upstream section of the response point which could cope with the demand of the

response point(Hoekstra et al. 1991).

Moreover, the development of information technology has widened the difference between the response point and the locations of the inventory. Forrester's supply chain model proposed that the information and material response points are the same. With this model, many simulations were done. However, the development of information technologies such as POS(point of sale), EDI(electronic data interchange), and EC(electronic commerce) the division of information response point and the material response point became inevitable. Cases where sales information of the retailer are immediately transmitted to the manufacturer, thus helping the production plan is becoming more frequent. In such a case, the manufacturer is considered to be the response point of the supply chain, but it is highly likely that the location of the main inventory is at the distributor right before the retailer.

The alteration of the response point can be carried out in various forms, but joint ownership of information systems is used by many firms. In other words, it is a form where information on demand is kept jointly in the upstream point. If the consumer information is directly delivered to the upstream, it means that the response point is in a form of moving to the upstream. When the response point moves upstream, the inventory of the entire supply chain would be lowered. This is because in the supply chain, the push like management section would decrease whereas the pull like management sections will increase (Hoekstra et al. 1991). To conclude that a upstream movement of the response point is effective, a total cost approach to compare the trade-off relation between increased costs and improved profit caused by the shift of the response point should be made.

It is also possible to see whether the shift of the response point is going to be helpful in making the supply chain be more effective through the theory of constraints(TOC). According to Goldratt & Fox(1986), the entire flow of process should try to match the flow of constraints, and at the same time the constraint load should be lowered. Although the theory of constraints has previously been limited to the production process, this research believes that it can be applied to the supply chain process as well. Thus, as mentioned before, the meeting point of the push like management by the final consumer and the pull like management by the manufacturer in the production process could be called the point of constraint. This is because the joint ownership of the information systems and such is considered as a plan to lower the load of constraint point in the supply chain.

3. e-commerce

Definitions of electronic commerce given by various sources differ significantly. Some include all financial and commercial transactions that take place electronically, including electronic data interchange(EDI), electronic funds transfers(EFT), and all credit/debit card activity. Others limit electronic commerce to retail sales to consumers for which the transaction and payment take place on open networks like the Internet.

The first type refers to forms of electronic commerce that have existed for decades and result in trillions of dollars worth of activity every day. The second type has existed for a few years and is not yet very

large. We consider e-commerce as the first type in this research.

So many people cluster e-commerce as business to business(B to B) and business to customer(B to C). But this clustering is so simple that doesn't give enough practical implication. OECD suggest that existing e-commerce definition can be seen as differing because of three key elements; 1) activities/transactions, 2) applications, 3) communication networks. We use the OECD's definition tool and analysis the various types according three key elements.

4. Hypothesis

Based on premises, we suggest some hypothesis. E-commerce include the all types of information flows between companies on supply chain, we premise, and the goal of e-commerce is management of flows of information and material effectively and efficiently.

We exclude the general hypothesis gained through the diagnosis about supply chain structure. In this presentation, we only suggest some hypothesis.

Hypothesis - 1

The placement point of e-commerce in supply chain is near the response point.

Because response point is the bottleneck in supply chain and determine the whole supply chain performance. The improvement of flow in the bottleneck result in directly the total supply chain flow. But response point in supply chain means the only company(member) or function. E-commerce is the means the communication tools between companies or function. Therefore e-commerce place near th the response point, upstream or downstream.

Which point first has happened e-commerce in supply chain? As viewed in research background, the upstream activities of response point based on planning and downstream of that based on response to customer. So there is the difference of information and material activities between upstream and downstream. E-commerce type must be different from the response point.

The objectives of e-commerce at downstream to the response point are catch the demand information and response to the demand quickly. E-commerce focus on catch and creating the demand because response activities are related with logistics specially delivery activity in general. So many companies may use B to C type e-commerce for effective flow management.

Hypothesis - 2

The type of e-commerce is differ between upstream and downstream point.

The downstream e-commerce provides various marketing information to the customer such as price, product, promotion and so on. The downstream e-commerce must have plenty of information and various characteristics to the competitors. The content and construct of downstream e-commerce change to the time.

The upstream e-commerce to the response point based on planning mechanism. Demand is not continuous but intermittent, not small lot size but lumpy. Supply chain member in response point hold inventory for the customer service, make the partnership with suppliers for the stable supply.

The upstream e-commerce, to begin with, include order quantity, order time and so forth. But this type may not focus on supplier selection information like order qualifier, price. Decision making related to supplier selection is happened intermittently. For the partnership, buyer needs to make long period contract with a few suppliers. These buyers who are in response point make decision about order processing in day to day operation. The upstream e-commerce, therefore, probably require less quantity of information than downstream e-commerce.

Hypothesis - 3

Response point and stage density determine the e-commerce type

After analyzing the determinant factor on e-commerce type, we suggest, in particular, two variables, response point and stage density. Stage density means the number of supply chain member in each stage. We suppose that e-commerce is between two members, buyer and seller, one of them must be a response point. There are two alternatives which response point is in buyer or seller. The type of e-commerce also is affected by stage density. In this study, we suggest 3 alternatives, one-to-many, many-to-one, many-to-many. If two variables are considered simultaneously, total 6(2 by 3) cases are supposed.

Table 1 types of e-commerce based on response point and stage density

	One-to-many	Many-to-one	Many-to-many
Buyer response point	<ul style="list-style-type: none"> ✓ Downstream EC ✓ Seller is monopoly, ✓ Seller support buyer ✓ Buyer & Seller have almost equal power ✓ Coordination need ✓ Relatively long time need 	<ul style="list-style-type: none"> ✓ Downstream EC ✓ Buyer is monopoly, ✓ Seller support buyer ✓ Buyer drive EC 	<ul style="list-style-type: none"> ✓ Downstream EC ✓ Middleman need ✓ Seller support buyer ✓ Near buyer middleman drive EC
Seller response point	<ul style="list-style-type: none"> ✓ Upstream EC ✓ Buyer's simple function ✓ Seller is monopoly ✓ Seller drive EC 	<ul style="list-style-type: none"> ✓ Upstream EC ✓ Buyer support seller ✓ Buyer & Seller have almost equal power ✓ Coordination need ✓ Relatively long time need 	<ul style="list-style-type: none"> ✓ Upstream EC ✓ Middleman need ✓ Buyer support seller ✓ Near seller middleman drive EC

4. Research Methodology

For the reasonable research, we will use survey method as data collection tool.

We survey on major industries like electronic, chemical, steel, automobile and fashion or construct. These industries begin e-commerce lately in Korea relative to music, book industries. The main objective is analysis the effect of e-commerce on traditional industries, specially is the e-commerce development

process. These sample, therefore, are most effective for this study. Analysis of supply chain structure will base on company level, not business unit, not corporate level. Using the statistical package like SAS or SPSS, regression, MANOVA, etc. will be applied.

5. Implications

This study will provide following implications

- 1) Point out firstly management point in supply chain
- 2) Build and management of e-commerce must be differ to industries
- 3) Provide e-commerce placement point to the supply chain members
- 4) By finding their position in supply chain, supply chain member must response of e-commerce to their industry participating.
- 5) Provide the effective e-commerce development process and type to the member
- 6) Applying constraint theory to the supply chain and e-commerce, wide the research area to the researchers.

References

- [1] 김태현, 글로벌 시대의 Supply Chain Management, 박영사, 1999.
- [2] 문성암, 공급체인 재고에 대응점 변화가 미치는 영향에 관한 연구, *동의논집*, 31 호, 1999.
- [3] 문성암, 제조업자의 제품전략이 유통경로구조에 미치는 영향에 관한 연구, *마케팅관리 연구*, 제 4 권, 제 2 호, 1999.
- [4] Anderson, Erin and Barton A. Weitz, The Use of Pledges to Build and Sustain Commitment in Distribution Channels, *Journal of Marketing Research*, 29(February), 1992, pp. 18-34.
- [5] Bakos, J., A strategic analysis of electronic marketplaces, *MIS quarterly*, 15, 3, pp. 295-310, 1991.
- [6] Barney, Jay B. and William Hesterly, Orgainzational Economics: Understand in the Relationship Between Organization and Economic Analysis, in Handbook of Organizational Studies, S.R. Clegg, C. Hardy, and R. Nord, eds. Thousnad Oaks, CA: Sage Publicaions, 1996, 115-47.
- [7] Benjamin, R., and Wigand, R., Electronic markets and virtual value chains on the information superhighway, *Sloan Management Review*, 36, 2, pp. 62-72, 1995.
- [8] Berry, D., D.R. Towill and N. Wadsley, Supply Chain Mangament in the Electronics Products Industry, *International Journal of Physical Distribution and Logistics Management*, Vol. 24, No. 10, 1994, 20-32.
- [9] Bowersox, Donald J. and David J. Closs, *Logistical Management : The Integrated Supply Chain Process*, The McGraw-Hill Companies, 1996.
- [10] Bucklin, L., A theory of channel control, *Journal of Marketing*, 37, 1973, 39-47.
- [11] Cespedes, F., Control versus resources in channel design: Distribution differences in one industry, *Industrial Marketing Management*, 17, 1988, 215-227.
- [12] Chandler, A.D., *Strategy and Structure*, MIT Press, Cambridge, MA., 1962.

- [13] Child, J., Organizational Structure, Environment, and Performance: The Role Strategic Choice, : *Sociology*, 6(1), 1972, 1-22.
- [14] Colecchia, Alessandra, "Defining and measuring electronic commerce," Organization for Economic Co-operation and Development(OECD), 2, rue Andre-Pascal, 75775 Paris Cedex 16, France, 1999.
- [15] Eisenhardt, Kathleen M., Control Orgainaitonal and Economic Approaches, *Management Science*, 31, 1985, 134-49.
- [16] Goldratt, Eliyqhu M. and Jeff Cox, *The Goal*, North River Press, 1984.
- [17] Goldratt, Eliyqhu M. and Robert E. Fox, *The Race*, New York : North River Press, 1986.
- [18] Heide, Jan B., Inter-Organizational Governance in Marketing Channels, *Journal of Marketing*, 58, 1994, 71-85.
- [19] Hoekstra, Sjoerd and Jac Romme, *Integral Logistics Structures*, Industrial Press Inc., 1991.
- [20] Jones, Daniel T., Peter Hines and Nick Rich, Lean Logistics, *International Journal of Physical Distribution and Logistics Management*, Vol. 27, No. 3/4, 1997, 153-173.
- [21] Lassar, Walfried M., and Jeffrey L. Kerr, Strategy and control in supplier-distributor relationships: An agency perspective, *Strategic Management Journal*, vol. 17, 1996, 613-632.
- [22] Lee, H. L. and C. Billinton, Managing Supply Chain Inventory : Pitfalls and Opportunities, *Sloan Management Review*, Spring, 1992, 65-75.
- [23] Lee, H., V. Padamanbhan, and S. J. Whang, Bullwhip Effect in a Supply Chain, Working Paper, Stanford University, November 30, 1996.
- [24] Lee, Ho Geun & Theodore H. Clark, Impacts of the Electronic Marketplace on Transaction Cost and Market Structure, *International Journal of Electronic Commerce*, Vol. 1, No. 1, pp. 127-149, Fall 1996.
- [25] Miller, D. and P.H. Friesen, Portrs(1980) generic strategies: An Empirical examination with American data, *Organizaion Studies*, 7, 1986, 37-55.
- [26] Miller, D., Relating Porters business strategies to environment and structure: Analysis and performance implications, *Academy of Management Journal*, 31, 1988, 280-308.
- [27] Porter, M. E., *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, The Free Press, 1980.
- [28] Sawhney, Mohanbir and Steven Kaplan, The Emerging Landscape of Business to Business E-Commerce, working paper, 1999. Towill, D. R., M. M. Naim and J. Wikner, Industrial Dynamics Simulation Models in the Design of Supply Chains, *International Journal of Physical Distribution and Logistics Management*, Vol. 22, No. 5, 1992, 3-13.
- [29] Towill, Dennis R., Industrial dynamics modeling of supply chains, *International Journal of Physical Distribution and Logistics Management*, Vol. 26, No. 2, 1996, 23-42.
- [30] Wikner, J., D.R. Towill and M. Naim, Smoothing supply chain dynamics, *International Journal of Production Economics*, 22, 1991, 231-248.