

## **Future Impacts of RFID on Supply Chain Management and Redesigning the Distribution Structure of Seafood in Korea \***

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### **I. Introduction**

A number of contradictions are maintained in the field of seafood distribution, despite the government's ongoing efforts to redesign the

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distribution structure of seafood through improvement in low-cost high-efficiency systems. The distribution structure of seafood is extremely vulnerable to the uncertainty and seasonal factors in the process from production to sale, and much difficulty is thus inevitable in the supply control. Seafood, furthermore, have structural problems that disturb standardization for efficient distribution due to the dispersed small-scale consumption, price unelasticity, uncertain production, difficulties in production planning, and various types and shapes of products. This inefficient structure requires excessive distribution cost, due to sizable distribution facilities and excessive equipment required from the production site. Such a distribution structure is important in securing the safety of seafood through systematic quality and hygiene control of seafood. The only way to enhance consumers' confidence in seafood should be a comprehensive management system to produce and supply safe seafood, by establishing a foundation for supplying high-quality safe seafood.

Redesigning the marine product distribution structure, therefore, needs to be discussed in view of the entire Supply Chain Management (i.e. SCM) for the seafood distribution channel, rather than the change of a system or market for a specific transaction. It appears that the consistently mentioned inefficiency of marine product distribution needs to be solved by redesigning the entire structure of marine product distribution, including the consignment markets of production areas, the wholesale markets of consumption areas, and similar wholesale markets - rather than by attempting to change the transaction system in a specific market or specific consumption area.

It is then required to first to consolidate tracking efficiency from production through the distribution stages, as well as establish a monitoring system for incidents related to seafood. The traceability system for seafood is considered as the distribution infrastructure established in RFID deployment. Such infrastructure is a new measure to improve the structure currently causing inefficiency and excessive distribution cost. An

important technology to accomplish such a task is Radio Frequency Identification (i.e. RFID) for which active discussion is under way in the field of information technology<sup>1)2)3)4)</sup>.

This study discusses the seafood distribution structure in view of the supply chain, to present an effective foundation for supplying seafood throughout production, distribution, and consumption. This is achieved by introducing RFID in a ubiquitous environment, and suggesting far more efficient control planning throughout the seafood distribution channel in view of the expected effects resulting from the introduction.

## II. Literature Review

### 1. Distribution structure of seafood in Korea

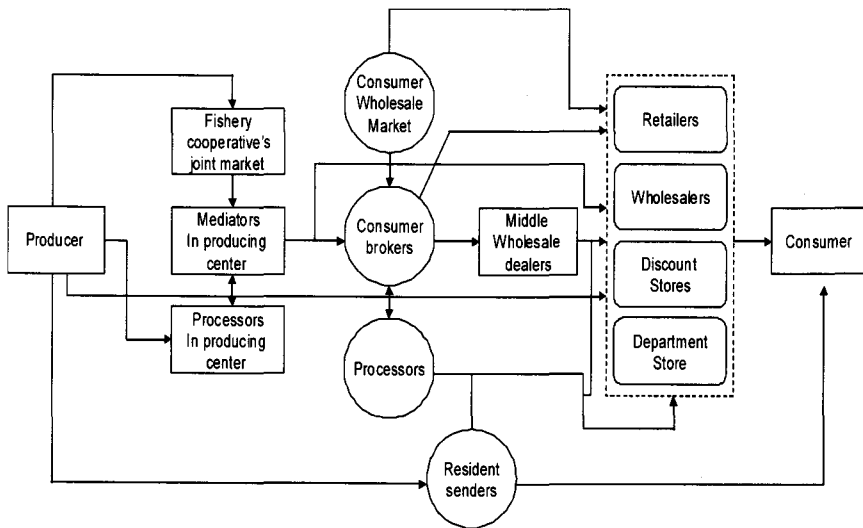
#### (1) Distribution channel of seafood in Korea

The seafood distribution system mainly consists of 'channel distribution' through the relevant organizations of the National Federation of Fisheries Cooperatives (i.e. NFFC), which is based on consignment markets of production areas and wholesale markets of consumption areas. The ownership of the seafood caught by fishermen is transferred to mid wholesalers mainly through the 1st auction at

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- 1) K"arkk"ainen, M. "Increasing efficiency in the supply chain for short shelf life goods using RFID tagging", *International Journal of Retail and Distribution Management* Vol.31, No.10, 2003, pp.529-536.
  - 2) Juban, R.L. and Wyld, D.C., "Would you like chips with that?: consumer perspectives of RFID", *Management Research News*, Vol. 27, No.11/12, 2004, pp.29-44.
  - 3) Nierreyen, A. and Park, M.H,"Smart tags for your supply chain", *The McKinsey Quarterly* 4. 2003.
  - 4) Smith, A.D. "Exploring radio frequency identification technology and its impact on business systems", *Information Management and Computer Security*, Vol. 12, No.1,2005, pp.16-28.

consignment markets of productions areas, and then to next mid wholesalers of the wholesale markets of consumption areas through the 2nd auction. The seafood is then transferred through wholesalers, to similar wholesale markets, then to retailers, then finally to consumers. <Fig.1>. shows the marine product distribution channel from producer to consumer.

<Fig. 1> Distribution Channel of Seafood for Fresh Fish



(2) Issues of seafood distribution structure

The stages of seafood distribution has increased to distribute the risks such as price unelasticity, uncertain production, and dispersed small-scale consumption characteristic of marine product process and distribution. It is impracticable, furthermore, for a single person to handle entire marine product distribution due to the different distribution characteristics resulting from the various product types. Another problem is that

standardization and classification are impracticable because the majority of distributors are small and many of them join complexly in the distribution channel. Such issues make it necessary to reduce the cost of the distribution structure and to enhance transparency.

The current issues in Korean seafood distribution system can be described for each of the production and consumption areas:

In regard to the production area, NFFC-led consignment markets are operated mainly for auction because of their small scale and poor facilities, and the fishermen's awareness for improving the value added through classification, processing, packing, and so on, is low. Some consignment markets, furthermore, experience problems in management due to volume reduction resulting from the reduction in caught fish, and the mid wholesalers and shippers of the production area continue to depend on mid wholesalers of the consumption area to ensure the sale and price. To make matters worse, illegal sale of fish continues. In regard to the consumption area, there is an established habitual transaction relationship between mid wholesalers (or collecting merchants) of the production area and mid wholesalers of the consumption area. This makes it difficult to establish the transaction order of the wholesaler market (e.g. conflicts on fee collection, auction by record). In addition, the facility of the wholesale markets and administrative guidance are both poor.

In regard to the distribution channel, there is a structural problem of inferior traditional fisheries marketplace in competitiveness compared with newly emerging large distributors such as comprehensive wholesale stores. It is required to continuously enhance the efficiency of competition among wholesale markets, fishermen's organizations, and private distribution systems. The unification of the seafood supply chain appears to integrate the distribution through fast collection and distribution of seafood and to improve the administrative convenience in the preparation of production statistics.

## 2. Previous research on supply chain management

### (1) Literature reviews on SCM

The essence of SCM is to integrate the whole structure by consistently managing the relevant companies and the flow of all products and information from the raw material to the end users<sup>5)</sup>. SCM can be defined as the management of the whole flow of the distribution channel from the supplier to end user; this also means cooperation covering the entire area of the management process, rather than between individual members, throughout the whole channel<sup>6)</sup>.

The objectives of SCM can be summarized into two brief points: first to maximize response of customers and second to minimize the cost required for SCM. The former is related to flexibility and on-time delivery, and the latter is related to procurement, manufacturing, and transportation<sup>7)8)</sup>. The fundamental objective can be described as to integrate the structure and process of various supply chains by facilitating not only the flow of products and services but the flow of information for delivering the values required by customers<sup>9)</sup>.

SCM-related precedent studies have mainly dealt with the SCM partnership<sup>10)11)12)</sup> accomplishments from the introduction of SCM<sup>13)14)</sup>,

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- 5) Bechtel, C. and Jayaram, J., "Supply chain management: a strategic perspective", *The International Journal of Logistics Management*, Vol.8, No.1, 1997, pp.15-30.
  - 6) Cooper, M.C. and Ellram, L.M., "Characteristics of supply chain management and the implications for purchasing and logistics strategy", *The International Journal of Logistics Management*, Vol.4, No.2, 1993, pp.13-24.
  - 7) Davis, T., "Effective supply chain management", *Sloan Management Review*, Vol.39, No.4, 1993, pp. 35-39.
  - 8) Lancioni, R.A., Smith, F.A. and Oliva, T.A. "The role of the internet in supply chain management", *Industrial Marketing Management*, Vol. 29, No.1, 2000, pp.45-56.
  - 9) Sridharan, U.V., Canies, W.R. and Patterson, C.C, "Implementation of supply chain management and its on the value of firms", *Supply Chain Management: An International Journal*, Vol.10, No.4, 2005, pp.313-318.
  - 10) Handfield, R.B and Nichols, E.L. *Introduction to supply chain management*, Prentice

and factors contributing to the success of SCM<sup>15)16)</sup>. In regard to the factors contributing to the success of SCM, in particular, Robert and Kilpartick (2000)<sup>17)</sup> suggested, such factors as, corporate strategy development, information collection, partnership, removal of fear against SCM, organizational change, and evaluation and measurement systems.

## (2) Previous studies on Impacts of RFID on SCM

Radio Frequency Identification (i.e. RFID) is automatic identification technology that replaces the existing bar-code system to interpret and record information on a tag using a contactless reader. It can be an innovative technology that enables information management based on efficient product identification and traceability. RFID is also necessary for SCM, which is the supply network management system for integration of production, storage, delivery, and sale. The expansion of the RFID market, therefore, is closely related to the timing and extent of each company's introduction of SCM.<sup>18)19)20)</sup>

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Hall, Upper Saddle River, New Jersey., 1999.

- 11) Lee, H.L. and Whang, S., "Decentralized multi-echelon supply chain: incentive and information", *Management Science*, Vol.45, No.5, 1999, pp.633-640.
- 12) Stuart, L.F. and McChitcheon, D.M."The manager's guide to supply chainmanagement", *Sloan Management Review*, 2000, March-April.
- 13) Fisher, M.L., "What is the right supply chain for your products?", *Harvard Business Review* , March-April, 1997, pp.106-116.
- 14) Tyndall, G., Gopal, C. and Kamauff, J., "Supercharging supply chain", *Purchasing and Supply Chain Management* Vol.12, 1999, pp.9-10.
- 15) Akintoye, A., McIntosh, G. and Fitzgerld, E., "A survey of supply chain collaboration and management in UK construction industry", *European Journal of Purchasing and Supply Management*, Vol. 6, No.3, 2000, pp.159-168.
- 16) Boddy, D.C., Cahill, M., Charles, F.K., Heidi, F.K., and Macbeth, D., "Success and failure in implementing supply chain partnering: an empirical study", *European Journal of Purchasing and Supply Management*, Vol.4, No.4,1998, pp.143-151.
- 17) Robert, P.D. and Kilpartick, J., "Six supply chain lessons for the millennium", *Supply Chain Management Review.*, 2000
- 18) Angels, R., "RFID technologies: supply chain applications and implementation issues", *Information Systems Management*, Vol.22, No.1, 2005, pp.51-65.

The review of previous studies demonstrates that RFID has many advantages compared with the existing bar code system widely adopted to many businesses, though relevant investment performance is not ensured and technical improvement is still required. RFID is also believed to solve the problems of limited information storage capacity of the existing bar code because RFID will have a far more capacity to store, and be able to provide large amounts of information for suppliers and retailers. This study also expects many advantages of RFID through the marine product distribution channel: cost reduction due to automation from the inspection stage, reduced human resources required for inventory management, prevention of theft for shelf products, and enhanced control of product authenticity. Comparison of RFID and bar codes also indicates that RFID has characteristics appropriate for the marine product distribution channel and the environments: contactless communication invulnerable to pollution, high resistance of the tag to external environment (e.g. temperature), and no line of sight required between tag and reader.

In regard to the effects of RFID on SCM, Asif (2005)<sup>21)</sup> proposed that many enterprises (e.g. Wal-mart and Gillette) introduced RFID and their suppliers were required to use RFID within a few years in the future. He also mentioned that Wal-mart accomplished many advantages from the introduction of RFID: reduction of labor, stock, and transportation cost; reduction of stolen products; and reduction of the supply chain cost resulting from sold-out products.

The use of RFID in SCM is generally known to produce various

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- 19) Nierreyen, A. and Park, M.H., "Smart tags for your supply chain", *The McKinsey Quarterly* 4. 2003.
  - 20) Prater, E., Frqzier, G.V. and Reyes, P.M., "Future impacts of RFID on e-supply chains in grocery retailing", *Supply Chain Management: An International Journal*, Vol. 10, No.2, 2005, pp.134-142.
  - 21) Asif, Z., "Integrating the supply chain with RFID: A technical and business analysis", *Communications of the Association for Information Systems*, Vol. 2005, No.15, pp.393-427.



positive effects: automatic information detection, guarantee of accurate delivery date, and prevention of stock loss or theft. Its perfect automation and visibility, furthermore, can reduce the employment cost for the distribution center, enable efficient stock management, and increase supply network efficiency. Various studies on the RFID application are also introduced with the objective of ensuring traceability of grocery items such as fruit, beef, and processed food. Mousavi et al. (2002)<sup>22</sup> described optimizing the production with a monitoring system for processed meat management, attaching RFID tags on trays to enhance traceability, and checking the stock status on a real-time basis to reduce the relevant cost in connection with existing application systems.

Introduction of RFID thus aims for direct cost reduction in the short term, but, in the long term, it appears to alter the existing business process and thus provide competitive advantage. SCM combined with the introduction of RFID, therefore, will enable practical collaboration and value chain integration by controlling the flow of enterprise resources as it could instantly monitor and trace not only simple transaction information but the whole procedure throughout production, discharge, shipping, delivery, and sale. The introduction and application of RFID, in summary, appears to enhance the efficiency and reduce the cost throughout the supply chain, and to improve the existing business process by enhancing the visibility of the supply network, suppliers, and customers. It appears, in view of such a trend, that RFID can be combined with SCM and CRM (i.e. customer relationship management) in the agriculture, live stock, and fisheries industries, and that RFID can be applied to ensure the safety and traceability of food.

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22) Mousavi, A., Sarhadi, M. Lenk, A. and Fawcett, S, "Tracking and traceability in the meat processing industry: a solution", *British Food Journal* Vol.104, No.1, 2002, pp.7-19.

### 3. Application Plan

#### (1) Needs for seafood SCM and RFID

Seafood have a variety of shapes, require temperature control, and tend to be very easily spoiled. These setbacks should be the typical problematic characteristics of the marine product distribution structure. The current study considers it reasonable that marine product traceability should be discussed from the viewpoint of the supply chain, in consideration of the difficulties in supply control, the fluctuating value of the products, and the restriction of time and space due to the strong spoilage characteristics. The reason for the discussion from the SCM point of view is because the traceability system needs to trace all the information through the production and distribution process of companies on the supply chain, and to prove the safety of the seafood. It seems, furthermore, that traceability should cover the whole life cycle of seafood through production, distribution, and consumption, to ensure a practical production traceability system. This is because large risks result from the disconnection between the production and distribution stages along the seafood distribution channel.

In response to this issue, Kärkkäinen and Holmstrom (2002)<sup>23)</sup> argued that RFID is an effective information collection system to solve the problems of the supply chain, and that collected information will thus provide the advantage of showing the stock and tracing the sales channel.

The needs for marine product traceability, therefore, should be recognized by marine product farmers and suppliers (i.e. the beginning of the supply chain), and thus introduced along with RFID to enable the

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23) Kärkkäinen, M. and Holmstrom, J., "Wireless product identification: enabler for handling efficiency, customization and information sharing", *Supply Chain Management: An International Journal*, Vol.7, No.2, 2002, pp.242-252.

combination with effective SCM for integrated management of production, storage, transportation, delivery, and sales in the seafood industry.

As a result, RFID will be used as a tool for traceability and an alternative for effective supply management, to collect and accumulate traceability information in order to enable instant reference as well as to enable integrated management of the supply chain<sup>24)</sup> Automatic tracking was stressed by a number of previous studies on effective supply management based on a traceability system. The key objective of a traceability system is to provide best-fit technology to minimize the effort required to seek accurate and appropriate information on the movement of material (Smith, 2005). This study considers RFID as the best system for marine product traceability in view of safety and profit.

Therefore, RFID is an effective information collection technology to solve the problems of the marine product supply chain. The information thus collected on the supply chain provides the advantage of being able to trace the product and evaluate its safety on the channel (Rizzoto and Wolfam, 2002). In view of such advantage, it is appropriate to apply RFID technology for marine product traceability.

## (2) SCM approach for redesign of seafood distribution structure

SCM appears to be easily applicable for seafood with a channel distribution composed of a direct transaction that is simpler and more transparent than a market distribution because a long supply chain and many product movement stages increase the number of middlemen involved in the transaction process and makes traceability difficult. It appears very difficult to ensure the traceability for seafood if they pass through a wholesale market on the distribution channel because such a

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24) Smara's, J. and Holmström, J., "Viewpoint: reaching the consumer through e-grocery VMI", *International Journal of Retail & Distribution Management*, Vol. 28, No.2, 2000, pp.55-61.

market aims at quickly distributing a large quantity of products by auction based on grade. Such traceability reveals larger differences depending on the condition of the marine product distribution channel. The marine product supply chain including large distributors (e.g. wholesale store, department store) is highly organized because the suppliers must follow the distributors' policy or procedure. Those not including large distributors, on the other hand, show lack of traceability because the products are very diverse and the origin and destination are not known due to the poorly organized and systemized distribution channel.

It is required, therefore, to consider the marine product distribution management method, the extent of the products, and the complexity of the supply chain for redesign of the marine product distribution structure. As a result, it should be possible to differentiate directly transacted seafood or to vertically integrate the supply chain throughout production, processing, and distribution. This enables tracing of the seafood and relevant information before and after each stage in the supply chain (e.g. production, processing, distribution, and sale). It should also be possible to apply the traceability system for seafood exporters in accordance with appropriate hygiene safety standards. It is necessary to differentiate the seafood requiring accurate inspection from the products which do not require such inspection based on the basic characteristics of the products. This differentiation of products will make it easier to find out a group of products which need to apply information technology to provide more information. SCM should also be considered in evaluating seafood that can be directly transacted as well as those whose supply chain (i.e., production, processing, and distribution) can be vertically integrated.

The plan, therefore, should provide far more efficiency in overall management rather than providing simple information within the supply chain, because it needs to create greater value than the investment in each stage of production to consumption.

### (3) Expected benefits of RFID as an effective tool for seafood SCM

The general benefit of RFID is described as the downstream of the seafood supply chain resulting from the effects of the automatic incoming and outgoing process - such as cost reduction, workforce reduction, theft prevention, certificate control, and effective stock control. In view of supply chain management, however, the seafood supplier also receives benefits. The collaboration level is enhanced and marine product traceability increases the value delivered to the entire supply chain system. The advantages of RFID to be accomplished as a tool for marine product traceability, therefore, should be proportional to the value delivered to the end consumer in terms of the efficacy of the seafood.

The introduction of RFID as traceability technology appears to verify the systematic and hygienic distribution process by monitoring the whole supply chain, and to assist recording and tracing the products flow and characteristics. It is expected, as a result, that RFID will support the whole supply chain, rather than the individual company that has introduced the technology. This RFID technology will improve issues such as existing inefficiency, stock sold-out, and frequent theft, although many distributors are waiting for standardization of the technology and a reduction in the associated deployment cost<sup>25</sup>).

Each entity on the supply chain can actually accomplish improved effects of distribution - such as cost reduction, higher transaction speed, and enhanced accuracy - in the field of logistics and transportation<sup>26</sup>). Some accomplishments were made in the field of distribution network management, such as removal of unfair distribution stages, enhanced food safety and reliability, product differentiation through restriction of imitations, and reduction in the loss resulting from the distribution of

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25) Smith, A.D. "Exploring radio frequency identification technology and its impact on business systems", *Information Management and Computer Security*, Vol. 12, No.1,2005, pp.16-28.

26) Angels, R., "RFID technologies: supply chain applications and implementation issues", *Information Systems Management*, Vol.22, No.1, 2005, pp.51-65.

counterfeit products<sup>27)</sup>.

### **Ⅲ. Case Study : Lotte Mart's introduction of traceability system**

#### **1. Strategic Policy of Ministry of Maritime Affairs and Fisheries of Korea**

The introduction of the traceability system by the Ministry of Maritime Affairs and Fisheries appears to aim at responding to the nation's growing attention to food safety, resulting from the use of some inferior food materials in Korea. This is extended to proactively prepare for the future introduction of traceability outside Korea.

Lotte Mart participates in the demonstrative project prepared as a part of the implementation strategy in the 'Comprehensive Plan for Quality Improvement and Safety Control of Marine Foods' proposed by the Ministry of Maritime Affairs and Fisheries in 2004. Lotte Mart introduced the seafood traceability system, as of 2005, for three items (i.e. oyster, laver, and fresh fish) as the first demonstrative project of the seafood traceability system at the feasibility study in 2004. Four hundred million Korean Won (approx. USD 400,000) was invested in the project, which is planned to gradually increase the number of items covered from 2005 to 2008 and eventually expand coverage to all seafood.

#### **2. Lotte Mart's introduction of seafood traceability system**

Lotte Mart's participation in the seafood traceability system was led by the 'Consortium for Demonstrative Projects on Marine Product Traceability.

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27) Prater, E., Frqzier, G.V. and Reyes, P.M., "Future impacts of RFID on e-supply chains in grocery retailing", *Supply Chain Management: An International Journal*, Vol. 10, No.2, 2005, pp.134-142.

The project objective was to remove the vulnerability in the risk control from the production to distribution stages (e.g. disease of farmed seafood, unclear hygiene control). Lotte Mart, furthermore, considers the safety of Seafood in the future as the essential factor in enhancing the producers' competitiveness, and expects that marine product traceability can help make the product differentiated and distinguished in the long run.

Lotte Mart currently focuses on the stabilization of the traceability system and its publicity through in-store advertisement and distribution of leaflets. They intend, instead of expecting short-term accomplishments, to make their customers aware through the traceability system, of the confidence in the safe and acceptable processing of seafood.

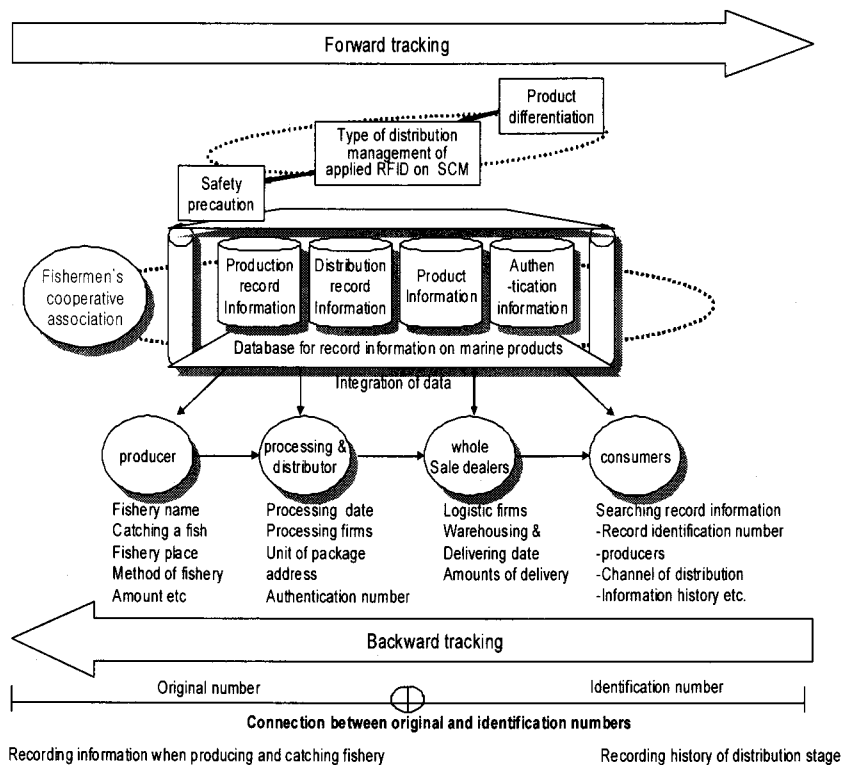
The information on seafood can be verified by customers at the store: the Lotte Mart visitors can see, from the in-store monitor, the origin, hygiene control data, processing information, and the producer's contact number of the marine product. If a consumer wants to check the record of the product that he wishes to purchase, for example, he can do so by entering the identification number in the monitor located at the store or on the Internet (homepage address: [www.traceseafood.net](http://www.traceseafood.net)) at home. This system provides the customer with detailed information on the product (e.g. condition, weight, producer with address, date and place of shipping and delivery, intermediate processors and their work places, and processing dates, if any).

In case of the demonstrative items such as oyster, laver, and fresh fish, the product record can be traced from production to sales when the traceability number entered in the traceability reference kiosk in the store. Lotte Mart's accomplishment at present, that is, as of the early stage of the project, should be its enhanced positive image that it has achieved by ensuring safety for items covered by the marine product traceability system. It appears that producers and distributors' competitive position will be improved considerably in the future if system coverage is expanded and relevant information including safety is properly publicized.

### 3. Suggestion for introduction of RFID as tool for traceability system

<Fig. 2> conceptually shows the process where RFID shares information among the phased traceability databases along the seafood distribution channel throughout the production, processing, distribution, wholesale, and retail stages before reaching the end consumers. RFID enables the suppliers to see which distributor deals with the respective product and which retailer sells it, and the end consumer to see where the product is produced and how it is processed and distributed.

<Fig. 2> Structure of Seafood combined with RFID





At the production stage, as shown in <Fig. 2>, the traceability database saves the producer information, product name, shipped quantity, when, where, how the product was produced, and so on. In the next stage of processing, the product is given additional information such as processing date, processor address, processed quantity, packing unit, storage condition and method. The database for distribution and logistics saves the shipper, shipping date and shipping method, locations, and the quantity. The retailer's database, saves the distributor, incoming and selling dates, expiration date, and so on.

The end consumers thus can see where the marine product was produced how it was distributed, and which process it passed through as the traceability information saved in the database of each entity is shared and integrated by all entities within the seafood distribution supply channel. The solution to the typical problems in seafood eventually requires effective information collection through production, processing, distribution, and sale. This means that the system needs to focus on the application of RFID from the view of marine product supply chain management.

In view of the supply chain, therefore, the RFID-based traceability system needs the participation of many members and with high levels of cooperation between producers and distributors for greatest profit from the RFID system. Such cooperation is important in order for the advantages and benefits to be obtained from the introduction of RFID and thus shared information. The RFID-based information sharing between the suppliers and distributors can sequentially integrate the business between them, produce such profit as to entire the whole supply chain scale, and eventually enhance the value produced from the introduction and application of RFID.

#### **4. Application of HACCP to SCM in Seafoods**

HACCP(Hazard Analysis Critical Control Points) can be a systematic

approach to the identification, assessment, and control of hazards<sup>28)</sup>. That is, it can be the systematic sanitation method to guarantee the food safety by identifying hazard factors generated from food supply chain from suppliers to final consumers. In actual fact, many stakeholder related to seafoods are not aware of investment for safety management of the seafood so that the function of sanitation management in each step of handling seafoods can be delicate in Korea. Because of this situation, many countries tend to introduce a traceability system and set up the new guideline for sanitation at perfection in each supply chain step. Meanwhile, many researchers suggested that HACCP could be generally considered more efficient because this approach focuses on resources on steps of seafood production to assuring seafood safety<sup>29)30)</sup>.

Therefore, as the alternative of solving this situation, this study can propose the supply chain in seafoods by comprehensive management in whole distribution channels. In the SCM in seafood perspectives, HACCP can take into account the whole seafood chain from the point of supply to the point of consumption when assessing hazards. It is believed to be more essential of the overall seafood process from supply to consumption than end-point testing.

Therefore, it is reasonable to assume that the application of HACCP to seafood supply chain and it can be the currently effective hazard control procedure. However, at present HACCP can only be implemented on a relatively fundamental level for seafood industry. Therefore, it will be required to consolidate several regimes on sanitation management related to HACCP by introducing traceability system or cold chain system and so forth. Through these complementary cooperations between regimes and

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28) Ropkins, K. and Beck, A.J., "Application of Hazard analysis critical control points (HACCP) to organic chemical contaminants in food," *Critical Review in Food Science and Nutrition*, Vol.42, No.2, 2002, pp.123-149.

29) Mayes, T., "HACCP Training," *Food Control*, Vol.5, No.3, 1994, pp.190-195.

30) Tompkin, R.B., HACCP in the meat and poultry industry, *Food Control*, vol.5, No.3, 1994, pp.153-161.

systems, seafood industry can establish the safety supervision to reinforce the seafood safety management.

### **5. Prerequisites for introduction of RFID**

RFID currently requires further technical advances for business applications because the technology is not mature yet in its cost and capability. RFID can be considered as the best tool for marine product SCM if interest in RFID grows and if it is thoroughly analyzed whether the benefit from the introduction of RFID will cover the entire supply chain. The prerequisites appear to be cost reduction of the RFID tag and the preparation of the ubiquitous technology standard. RFID is accompanied, as mentioned above, by issues of cost despite its potential advantages, such as accuracy and efficiency in employment. Such restrictions make it difficult to make the decision to adopt RFID.

Lotte Mart's introduction of the seafood traceability system is still at the preliminary stage for redesigning the distribution structure by recording the hygiene and safety factors and systemizing them by packing unit along the distribution channel through the production site, processing factory, and distribution center. More innovative change of the supply chain through the introduction of RFID at the traceability stage requires following issues solved in the policy and technology: The largest obstacle to the commercialization of RFID is its cost. The existing bar code provides enormous efficiency for worldwide logistics management due to advantages of standardization. It requires considerable cost and time, however, because human resources must be placed to attach the bar code and read the information.

RFID requires no human resources, on the other hand, in writing and reading the information because it uses radio frequency. RFID can store large amounts of information within a microchip and provide high speed identification. It can therefore accomplish, fast logistics management as well

as cost reduction. The price of an RFID tag is high, however, compared to other identification media. Of course, the price will decline as many manufacturers initiate mass production and the tag market establishes the framework of competition. The high tag price will not be a serious issue in the future, in conclusion, because technical development will lead to mass production. Thus, in RFID deployment, the benefits of the marine product traceability system will exceed the cost.

First, stable supply of RFID services should be guaranteed. This is important, otherwise the participating companies may be seriously damaged by the relevant loss. The tags can be supplied by any manufacturer without significant difference because the basic specification is internationally standardized. Periodical variation in supply may arise, however, and it could lead to price fluctuation, which may create a threat to cost competitiveness. It should be required, therefore, to first analyze the circumstances such as the consumer's response, participation of competitors, and the supplier's interest in the seafood for which RFID can be applied. Thus problems found should be solved and supplemented before gradually expanding coverage to more items.

It is expected that publicity effects will be automatically obtained and distributor's participation will become active if the traceability system is open first for the products fit for RFID, and then increasingly applied to more items in line with overcoming the problems resulting from the expansion of coverage. It is another issue of who will pay for the cost of RFID. It may result in disputes regarding who will pay for the cost if the distributors require the suppliers to attach the IC tags. The cost and effort for establishment of the RFID environment should be provided, in principle, by all participating entities because the RFID-based SCM aims for far more improved distribution and logistics efficiency and its benefits will be shared by all the participating entities through collaboration and cooperation. It is a problem, however, that the principles are not always followed.

Although most obstacles are removed and the conclusion that RFID has economic feasibility is reached, another cost issue may arise due to the substantially initial investment required for the introduction of the tags and readers and the connection with the information system. Governmental support is essential, therefore, for securing the quantity competitiveness, relieving the users' cost burden, and enhancing the technical capability of the RFID companies in Korea.

The second, the decision of frequency bandwidth is also another issue. The obstacles regarding technology and standardization, however, will be solved in the future. Application of RFID to logistics implies the global use of wireless resources, and thus the same frequency should be used worldwide. The frequency standardization, therefore, should be the core of the RFID dispute. This issue is also regarded to be settled in the very near future, however, because the international standard organization is close to a conclusion for the RFID frequency standard. As a part of the RFID standard, the bandwidth of 950 to 956 MHz in the UHF band proposed by Japan was recently accepted as the international standard.

It is still problematic, however, that the frequency for the establishment of the RFID environment in the field of distribution and logistics has not yet been decided. Standardization should also be discussed for the product with the tag attached, as well as the reader, the system, and the frequency bandwidth. The traceability for seafood will be established and it will provide positive achievements such as accurate stock control and improved productivity if the aforementioned issues on technical standardization and implementation cost are solved and the relevant company's plan to introduce RFID expands. First, this study approaches the flow from production to consumption in view of SCM beyond the partial discussion conducted so far, for the distribution structure of seafood. The discussion of SCM in the seafood industry first requires the establishment of the relevant infrastructure, for which the efforts of the government and demonstrative project participants are essential.

#### IV. Conclusion

It is required to establish the RFID environment in the logistics and distribution market of seafood as soon as possible, to enhance the competitiveness of RFID technology, and to consolidate international position in the RFID standardization procedure, by reviewing and sharing the results produced through the government's continuous efforts on appropriate projects. In this regard, the government is required to make an adequate government policy for RFID implementation, and should lead and also promote nationwide implementation of the RFID project among marine product producers and diverse distribution channels.

The introduction of RFID should be led by large distributors which have obvious financial advantage and negotiation power in the market, for the expansion of RFID in line with SCM over marine product suppliers and distributors. This also necessarily requires government support. It is required to enhance the recognition and participation of suppliers and distributors by proposing specific and practical models and results through positive governmental support and large distributors' active introduction of RFID.

Second, this study discussed the effects of RFID on the seafood SCM. Active participation of marine product farmers and producers (i.e. the origin of the supply chain) is based on the recognition of the importance of the seafood traceability system. The expansion of RFID to the original producers, therefore, should be accomplished by the RFID-based traceability system led by large distributors.

Third, this study expects that it is possible to accomplish effective SCM for integration of production, storage, transportation, delivery, and sale when RFID, the future ubiquitous technology, is used in the seafood distribution channel based on the expansion of awareness on the marine product traceability in view of SCM. The introduction of RFID, however,

necessarily requires reviewing the relevant investment and resulting profit. It is thus required to solve relevant issues such as the RFID tag price, connection with the existing system, and technology standardization.

The profit from the implementation of RFID will exceed the cost over the whole value chain if the aforementioned issues are well settled in the future and thereby a high level of cooperation is established between suppliers and distributors. The gains will exceed the cost when consumers and the size of the whole marine product industry are taken into consideration. Therefore, it is important to emphasize that the value of introducing and applying RFID will eventually continue to rise if the RFID is adopted by the entire whole supply chain.

## References

- Akintoye, A., McIntosh, G. and Fitzgerald, E., "A survey of supply chain collaboration and management in UK construction industry", *European Journal of Purchasing and Supply Management*, Vol. 6, No.3, 2000, pp.159-168.
- Angels, R., "RFID technologies: supply chain applications and implementation issues", *Information Systems Management*, Vol.22, No.1, 2005, pp.51-65.
- Asif, Z., "Integrating the supply chain with RFID: A technical and business analysis", *Communications of the Association for Information Systems*, Vol. 2005, No.15, pp.393-427.
- Bechtel, C. and Jayaram, J., "Supply chain management: a strategic perspective", *The International Journal of Logistics Management*, Vol.8, No.1, 1997, pp.15-30.
- Boddy, D.C., Cahill, M., Charles, F.K., Heidi, F.K., and Macbeth, D., "Success and failure in implementing supply chain partnering: an empirical study", *European Journal of Purchasing and Supply Management*, Vol.4, No.4, 1998, pp.143-151.
- Cooper, M.C. and Ellram, L.M., "Characteristics of supply chain management and the implications for purchasing and logistics strategy", *The International Journal of Logistics Management*, Vol.4, No.2, 1993, pp.13-24.
- Davis, T., "Effective supply chain management", *Sloan Management Review*, Vol.39, No.4, 1993, pp. 35-39.
- Fisher, M.L., "What is the right supply chain for your products?", *Harvard Business Review*, March-April, 1997, pp.106-116.
- Handfield, R.B and Nichols, E.L. *Introduction to supply chain management*, Prentice Hall, Upper Saddle River, New Jersey., 1999.



- Prater, E. and Frazier, G.V., "Future impacts of RFID on e-supply chain in grocery retailing", *Supply Chain Management: An International Journal*, Vol.10, No.2, 2005, pp.134-142.
- Juban, R.L. and Wyld, D.C., "Would you like chips with that?: consumer perspectives of RFID", *Management Research News*, Vol. 27, No.11/12, 2004, pp.29-44.
- Kärkkäinen, M. and Holmstrom, J., "Wireless product identification: enabler for handling efficiency, customization and information sharing", *Supply Chain Management: An International Journal*, Vol.7, No.2, 2002, pp.242-252.
- Kärkkäinen, M., "Increasing efficiency in the supply chain for short shelf life goods using RFID tagging", *International Journal of Retail and Distribution Management* Vol.31, No.10, 2003, pp.529-536.
- Lancioni, R.A., Smith, F.A. and Oliva, T.A. "The role of the internet in supply chain management", *Industrial Marketing Management*, Vol. 29, No.1, 2000, pp.45-56.
- Lee, H.L. and Whang, S., "Decentralized multi-echelon supply chain: incentive and information", *Management Science*, Vol.45, No.5, 1999, pp.633-640.
- Mayes, T., "HACCP Training, " *Food Control*, Vol.5, No.3, 1994, pp.190-195.
- Mousavi, A., Sarhadi, M. Lenk, A. and Fawcett, S, "Tracking and traceability in the meat processing industry: a solution", *British Food Journal* Vol.104, No.1, 2002, pp.7-19.
- Nierreyen, A. and Park, M.H, "Smart tags for your supply chain", *The McKinsey Quarterly* 4. 2003.
- Prater, E., Frqzier, G.V. and Reyes, P.M,, "Future impacts of RFID on e-supply chains in grocery retailing", *Supply Chain Management: An International Journal*, Vol. 10, No.2, 2005, pp.134-142.
- Ropkins, K. and Beck, A.J., "Application of Hazard analysis critical control points(HACCP) to organic chemical contaminates in food," *Critical Review in Food Science and Nutrition*, Vol.42, No.2, 2002, pp.123-149.

- Sridharan, U.V., Canies, W.R. and Patterson, C.C, "Implementation of supply chain management and its on the value of firms", *Supply Chain Management: An International Journal*, Vol.10, No.4, 2005, pp.313-318.
- Stuart, L.F. and McChitcheon, D.M "The manager's guide to supply chain management", *Sloan Management Review*, 2000, March-April.
- Smara's, J. and Holmstro'n, J., "Viewpoint: reaching the consumer thorough e-grocery VMI", *International Journal of Retail & Distribution Management*, Vol. 28, No.2, 2000, pp.55-61.
- Smith, A.D. "Exploring radio frequency identification technology and its impact on business systems", *Information Management and Computer Security*, Vol. 12, No.1,2005, pp.16-28.
- Tompkin, R.B., HACCP in the meat and poultry industry, *Food Control*, vol.5, No.3, 1994, pp.153-161.
- Tyndall, G., Gopal, C. and Kamauff, J., "Supercharging supply chain", *Purchasing and Supply Chain Management* Vol.12, 1999, pp.9-10.

## ABSTRACT

### **Future Impacts of RFID on Supply Chain Management and Redesigning the Distribution Structure of Seafood in Korea**

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In order to analyze the distribution channel of marine products in Korea, this study shows SCM approach to redesign of the marine distribution channel with case study related to previous literatures. In view of the supply chain and the future impact of RFID on the marine SCM on the recognition of the importance of the seafood traceability system, this study also provides the possibility to accomplish effective SCM for integration of production, storage, transportation, delivery, and sale when RFID is used in the seafood distribution channel based on the expansion of awareness on the marine product traceability. The traceability system for seafood is considered as the distribution infrastructure established in RFID deployment.

By introducing Lotte mart case, this case study also discusses the marine distribution structure in view of the supply chain, to present an effective foundation for supplying seafood throughout production, distribution, and consumption. This is achieved by introducing RFID in an ubiquitous environment, and suggesting far more efficient control planning throughout the seafood distribution channel in view of the expected effects resulting from the introduction.

In addition, as the alternative of solving this situation, this study propose

the supply chain in seafoods by comprehensive management in whole distribution channels. In the SCM in seafood perspectives, HACCP can take into account the whole seafood chain from the point of supply to the point of consumption when assessing hazards.

As the contributions of this study, this study emphasizes the seafood industry first should require the establishment of the relevant infrastructure, for which the efforts of the government and demonstrative project participants are essential.

Key Words : Supply Chain Management, RFID, Distribution Channel  
of Marine Products in Korea, HACCP, Case Study