

A Study on RFID Enabled Logistics and Supply Chain Management

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물류 및 공급체인관리 활성화를 위한 RFID에 대한 연구

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Abstract : This study provides for the enabling role of RFID technology in effecting supply chain management and logistics development. Furthermore, the findings of study reveal the recent application of RFID in international logistics and analyze the reason as the key factor of RFID widespread adoption and usage among suppliers.

Key Words : Supply Chain Management, Plan, RFID, International Logistics, Widespread

요 약 : 공급 체인 관리 및 물류 개발에 RFID 기술에 대한 국제적 적용에 대한 분석과 향후 활성화 방안에 대하여 연구를 수행하였다. 국제 물류의 RFID의 최근 응용 프로그램을 연구 분석하고 제조업체, 보관업체, 물류업체, 운송업체, 항만 및 유통업체간의 RFID 채택 및 사용의 핵심 요소를 범국가적, 국제적 물류체인과 연계하여 필요한 내용을 분석하고 국내에 필요한 요소 및 방안에 대하여 연구 기술하였다.

핵심용어 : 공급 체인 관리, 방안, RFID, 국제 물류, 널리

1. Introduction

Radio Frequency Identification(RFID) uses “tags that emit radio signals and devices called readers that pick up the signal”, with the ability to hold large amounts updateable information and is not limited by optical scanning(Ryan, 2004). Supply Chain is a network structure and pattern, centered on core enterprise, linking the supplier, with the manufacturer, the distributor, the retailer and the customer. Supply Chain Management(SCM), however, refers to the design, the programme and the control of the information flow, logistics and fund flow in Supply Chain. An upper-level SCM is of great importance in enhancing competitiveness of modern enterprises, to help increase the management level of enterprises, with analysis of RFID technology. Successful RFID applications in logistics and supply chain management bring benefits such as the rationalization of inventory management, optimization of transportation within logistics networks, efficient monitoring

of production and assembly processes, etc.. Companies choose to wait and see attentively what the first movers are doing in this field. This attitude is typical with introducing each new technology into an organization. Pros and cons as well as benefits and risks should be well explored and analyzed. RFID has rapidly emerged as an area of great promise for industry and retail. The significance of RFID is borne out by downright explosive growth in the use of RFID tags, which is projected to increase 450-fold over the next ten years(Bovenshulte et. al., 2007). Expectations and hopes are thus enormous. But how will the RFID field unfurl in the coming years, what role will logistics play in the international competition? Yet there is a lack of reliable analysis of the effects of RFID technology on supply chain management, technology vendors, and providers of technological services. This paper aims to introduce content and features of RFID in detail by describing and analyzing the needs and issues of RFID technology. Firstly, demonstrates characteristics and technical attributes of RFID application parts. Then, identifies application trends and developing options for action by expectation. Also, research issues and recommendation concerned the

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use of RFID technology throughout the study background. Overall, impacts of using RFID solution in supply chain management is described in this study. Research is employed in data collection and aims to gather an in-depth understanding of technology and investigates the why and how key enabler of SCM will bring the efficiency and importance without doubt.

2. Logistics Application Case

There is a need of RFID in society which can detect fault condition in order to prevent dangerous situation such as logistics accident. Accidents related to dangerous thing transportation is in the environment due to loss of life and property deterioration can cause great damage. For example, ship hazardous materials incident is about 1.2 billion dollars damage. Fire accident in middle east IC which caused 3,120 billion in costs to society. More than 15 years decrepit dangerous good's mobile tank is rapidly increasing 4 times in road transport of dangerous goods emergency. From 2005 to 2009, it was reached 274 to 1281. Large logistical problems connected directly with public safety incidents at the national level, so aggressive measures are necessary to prepare(MLTMA, 2012).

RFID's potential for the world economy is shown clearly by the three application areas that are most economically significant today retailing, logistics and automobile production. As the leading user of RFID, the retail sector is characterised by the fact that it must cooperate with a very large number of partners, the makers of consumer goods. Profit margins will remain very low for the foreseeable future due to intense price pressure in both retailing and the consumer goods industry(FMET, 2007). Profits can be increased mainly through productivity improvements and process optimization. Study analysed that hypermarkets, large superstores and discounters hold an 2 percent annually due to worldwide growth in transportation. International logistics will also profit greatly from RFID within the next five years. By about 2010, RFID implemented ubiquitously in transport containers in order to meet the growing demands of the globalised economy (Wamba and Chatfield, 2010). Due to constantly low margins, the best prospect for increasing profits is to enhance efficiency through automation and rationalisation. Industry representatives estimate that if these conditions are fulfilled, the adoption of RFID can achieve efficiency gains on the order of 5 to 10 percent; for the logistics sector, this correspond to productivity savings of 2.7 billion

dollars in 2006 and about 6 million in 2010, assumed that revenues increased by 2 percent annually due to worldwide growth in transportation(Bovenschulte et. al., 2007). Remarkably, the number of employees in logistics is likely to grow despite efforts to improve productivity. The following table illustrates the current research and applications of RFID in practice(Bovenschulte et. al., 2007). In contrast to retailing and logistics, the automotive industry, one of central industrial sectors, has been a pioneer in the use of RFID. To date, it has implemented RFID primarily in internal company processes.

The industry in the complexity of the product, the worldwide decentralisation of production sites, the declining vertical integration of automobile makers and the outsourcing of production steps, the necessity of customised mass production, and cut-throat global competition(Narsoo and Muslun, 2009).

Table 1 is identified characteristics of each RFID application parts. If see the category RFID will optimise existing processes and increase efficiency and productivity; applications will appear mainly in the areas of production logistics, control of systems and processes, full utilisation and availability of assembly lines, etc.. The technical attributes listed in the below table are a major focal point in current industry discussions. The reason for this is that RFID is still a developing technology, which ensures its technical issues remain a popular and important consideration, as this is the first step in a technology's development. The analysis of RFID attributes from a technical viewpoint is quite simple. RFID technology is its current lack of institutional standards, which will be examined below. While the electronic product code(EPC) is gaining acceptance, RFID still lacks a ratified global standard, hindering the technology's adoption. The EPC standard being developed for RFID is gaining momentum and is likely to become the first ratified RFID standard(Bovenschulte et. al., 2007).

The EPC is sponsored by many of the world's leading organisations, including Wal-Mart and Procter & Gamble.

In order to transfer existing applications to the entire supply chain and thus throughout the auto makers' ramified partner structure, RFID will have to harmonise with the industry's existing standards. An additional problem is that investing in the new technology involves considerable risks for the suppliers, which are generally small to medium-sized businesses period. The impact on employment cannot be inferred from the available data. However, rising per capita productivity due to RFID should help counteract the trend to contain costs by shifting production abroad.

Table 1. Characteristics of each RFID application parts

Category		Purpose and characteristic
Industrial	Process Control	Real time data control of process and inferior. Final Marker, Employee, date, Order No, Lot No can be saved and can be used on A/S.
	SCM	Path of Material, Information and cost from distributor to producer, detail shop, and customer can be observed and controlled. Easy to watch inventory for future.
	Security	Entrance security is providing for Industry, apartment, membership club such as where needs access security. Employee watching, cafeteria, security for personal computer system can be providing.
Distribution	Shipping	The tag that attached on cargo can track the status for real time during the shipping
	Storage Control	Receiving and departing of inventory can be monitored in real time, and authorized system increase effectiveness of process.
	Air Distribution	By adding information on RFID tag for cargo can track the pathway, monitored status, and more.
	Warehouse	Minimize the distribution process by keep track and controlling display, theft prevention brings profit. Running store without employee is possible.
Public Property	Library	Keep the track on inventory, and minimize renting process.
	Parking Highway	Decrease delay by automatic ticketing system, it can prevent parking violation, and charging high way usage.
	Transportation fee	It can be attached to transportation card of credit card. It has been used on the bus and the subway. It can be apply to airline, ship, tax and more.
Ect	Electric Bill	Electric bill can satisfy safety, identity theft, user's privacy as basic function.
	Patient Control	Easy to maintain patient. Patient's information as medical history can be maintained and saved easily and can be used well in the emergency and secured. Fast and convenience service can be provided. Can save the cost of medical care.
	Arboculture	The number and types of arbor can be kept in the data, and managed on real time.
	Livestock	Livestock control can be efficient by making the data of animal's info.

The technical attributes listed in the above table is a major focal point in current industry discussion (Table 2). The reason for this is that RFID is still a developing technology, which ensures its technical issues remain a popular and important consideration, as this is the first step in a technology's development (L. McCathie, 2011). The analysis of RFID attributes from a technical viewpoint is quite simple. Although barcodes are strong performer across the board, RFID is generally on par or superior to barcodes in all technical areas aside from the cost and usability of the technology.

Moreover, since labour costs play a relatively minor role

Table 2. RFID Technical Attributes

Attribute	RFID
Cost	Expensive, although costs are expected to drop significantly as uptake increases and economies of scale are created.
Ease of Use	The removal of human intervention and the level of automation negates any operating difficulties
Ongoing Innovations	RFID development is at a relatively immature state which means new applications are continually emerging.
Reliability and Accuracy	Some initial read reliability and accuracy issues have been discovered through pilots, however these are being solved as the technology matures. The technical nature of RFID and lack of human involvements means that theoretically its reliability and accuracy will be extremely high.
Line-of-sight	The radio nature of RFID means tags can be scanned remotely through packaging. It also leads to simultaneous reading where large numbers of items can be scanned within seconds.
Information and Data Properties	Tags can typically hold as little or as much information as required by users, although this is limited by cost. Tags will allow for each individual item in the supply chain to be uniquely identified. In addition to this, tags can be updated as they move along the supply chain creating an audit trail.
Environmental Considerations	RFID tags can be very durable with some tags withstanding harsh chemical and extremely high temperatures. They are not subject to weather, nor are they typically damaged by rough handling, as they are stored inside packaging with the product.

in the automotive industry(at 18% of expenses), it is unlikely that companies will compensate one-to-one for RFID investment costs through staffing cutbacks(Ryan, 2004). RFID plays a growing role in other application contexts, too, such as the chemical industry, pharmaceuticals, flight safety, the military, electronic ID documents, health care, transportation,etc. Despite the benefits of logistics, three fourths of respondents consider their current IT systems ineffective in supporting these operations. Moreover, half of the processes used for tracking and managing are currently manual. Many of the respondents recognize that this is an untenable situation. Fully half of them plan to tag existing assets with RFID tags(Heikkila and Holmstrom, 2006). This investment is coupled with two third of companies that plan on investing to improve logistics management functions in multiple areas. All of areas will benefit from RFID data. Study found issues about RFID which are:

1. Lack of awareness of the RFID. Recently some improvement to awareness and increase of market demand, but the changes remain insufficient. RFID Application interest is 30.4% - 36.8%. Lack of large-scale RFID success story imposes much difficulty to introduction of RFID.
2. RFID tags has high tag. Cost burden incurred by a relatively higher price of RFID tags than regular barcode tags. The RFID tag price has been going down by 1/10 from \$2 to 5 cents. Still too high for large-scale introduction, compared to bar-code.
3. Need for the extra investment. Cost burden incurred by the establishment of new infrastructure. Introduction of the RFID system requires the replacement or adjustment of the existing barcode system, incurring additional cost burden. High customizing cost for deployment because of the RFID technology's dependence on wireless frequency system. Interference between readers.
4. Lack of Market Confidence on RFID
Need to improve the market confidence on RFID technology. The key growth of RFID market demand tends to depend on the development of tag technology from the above issues. 900 MHz-range RFID technology has yet to overcome its vulnerability to metal or liquid environment as well as speed of mobile entities to make application on the item label sector somewhat difficult. Related works should be promoted and supported by the government. In 2018 total production in RFID expected to reach 25 billion dollars, more than 120,000 employment

creation and 0.92% level of contribution at GDP(Sanchez-Sinencio, 2007).

3. Recommendation

Preferably with the RFID tags, and implement tracking systems that will use the information. Companies should segment the logistics areas in which they have true domain expertise and technical assistance in areas where the enterprise is weak(Research and Markets, 2010). Put a key performance indicator program in place. It is not cost-effective or feasible to have customer-focused logistics capabilities without having the means to assess performance, determine corrective actions, and support continuous improvement programs.

Fig. 1 shows that generation of RFID which are passive, semi-passive, active, sensor and expected. Passive RFID requires tag reader which is possible a simplex information transmission. Otherwise in case of expected RFID requires smart tag in application platform which is possible a full duplex transmission. As a market analysis on price of each RFID that passive RFID is low \$1, semi-passive RFID is \$5, active RFID is \$30 - \$50, sensor RFID is \$50 - \$100 and expected RFID is over \$100. Furthermore, from expected RFID has seen 4 kind of possibilities through this research. The following possibilities which are self-regulating situational awareness. Full duplex transmission, strong marine logistics environment, self control and condition application. If use RFID effectively which can bring just in time logistics without severance and safety logistics without accidents(MLTMA, 2012). There are some reasons that SCM needs RFID(KTI, 2011).

1. RFID compared to barcode provides many benefits.
2. All the products and the need to trace the path of the cargo is being expanded.
3. Labor-saving technology, increasing demand for the introduction of RFID technology is needed.
4. RFID and automation technology companies that have adopted such a high level of visibility and traceability of the more competitive by strengthening the connection is secure.
5. Strengthen the regulation of food and pharmaceutical sector also contributed to the spread of RFID technology will be.
6. Supply chain complexity increases and virtualization will also facilitate the introduction of RFID.

7. RFID technology, smart phones, such as payment systems, is making inroads in various areas.

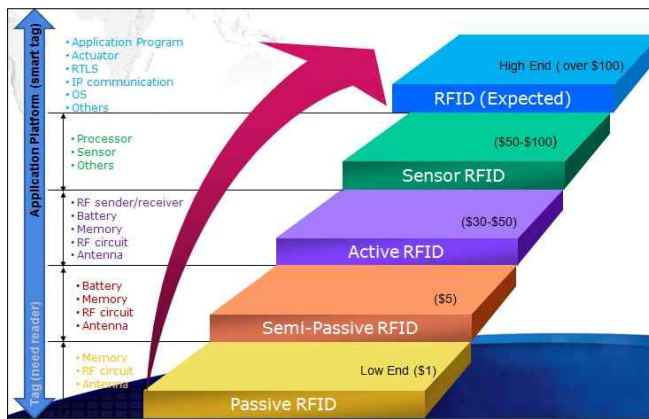


Fig. 1. Next generation of RFID(MLTMA, 2012).

This study's main recommendations to these actors thus include:

- To actively participate in decision-making on international frequency harmonization and to spur on the process.
- To expand the role of smaller users and providers of RFID technology in standardization processes.
- To facilitate early adoption of RFID by small to medium-sized companies.
- To synchronize the interests of users, citizens and customers in terms of data and consumer protection for the RFID applications with which they have close contact.
- To prepare existing disposal and recycling processes at an early stage for the anticipated large-scale adoption of RFID.
- To ensure the participation of European businesses in the EPC network.
- To expand the existing programs in research and technology policy that promote RFID, and to dovetail them more tightly together.
- To give appropriate emphasis to RFID in vocational and tertiary education.

Barcode technology has been used in SCM for more than three decades and during this time, it has proved successful in most areas of SCM. The technology has a comprehensive infrastructure, numerous global standards and continues to reinvent itself for use in new applications(Carlson and Silverman, 2009). Consequently, there is no doubt that barcodes will remain a prominent auto-ID solution for the foreseeable future. However, in an increasingly competitive

corporate environment, organisations are turning to their SCM practices to yield new levels of efficiency and attempt to gain, not only cost reductions through improved SCM, but also a competitive edge and improve their market share. This continual pursuit by the world's leading organisations has accelerated the rise of RFID and thrust it into the limelight. When Wal-Mart, the world's largest retailer, introduced a mandate for RFID compliance, many competitors followed suit and jumped on the bandwagon for fear of being left behind. This rapid rise of RFID technology has served to highlight the apparent lack on information and knowledge available to organisations investigating the differences of barcode and RFID technology in SCM. After analysing the research and findings, it is recommended that if organisations have any interest in SCM, they should consider deploying RFID(L. McCathie, 2011). Those implicated by one of the many mandates should endeavour to comply as soon as possible. Although there are contrasting opinions in relation to when organisations will receive a return on RFID investments, all literature indicates that there are savings to be achieved. However, before investing in RFID, entities need to make certain any deployment is future proofed ensuring that it is compatible with any developments to the EPC standard, which is expected to become the ratified standard. It is important that organisations continue to utilise and maintain their current barcode systems. It will be a long time before RFID replaces barcodes altogether, instead the technologies will converge or coexist so that organisations can yield the power of both to achieve new levels SCM efficiency. As entry barriers diminish, the technology will become more widespread, further lowering the cost of RFID.

4. Conclusion

Implementing RFID is a complicated procedure, but through the right planning it offers significant advantages to the business. Specific issues need to pay attention at each phase of RFID which are business analysis, testing, pilot implementation and full deployment of RFID system. Deploying RFID is a business decision. Consequently, it requires business and economical analysis. At the future the overall cost of the investment is expected to be significantly reduced, making the RFID a viable solution. In conclusion, RFID is key enabler of SCM will bring the efficiency and importance without doubt.

The RFID industry is emerging from its transition stage

as businesses are ramping up their use of RFID technology. It is expected that this profitable sector will attract more investors looking for opportunities on the horizon.

RFID technology, like the telephone, the Internet and the electronic commerce appears as an interactive innovation. In SCM, the more the stakeholders adopt RFID technology, the more considerable are its impacts which are expanded along the chain. Regarding RFID tagging strategies for example, outline the importance of supply chain stakeholders collaboration to achieve them as far as possible upstream in the supply chain (e.g. the contracting manufacturer who is far upstream), so as to maximize impacts (Positive network externalities) at the overall supply chain level is not far from this viewpoint when the study suggests that, in the context of SCM or RFID alliance, the adoption and use of RFID technology must stand as a collective activity. For the study, strategic data from RFID infrastructure are essential for supporting information and communication flows and communication loop in the supply chain. Moreover, the absence or failure of the technology in any part of the loop leads to inefficiencies in the whole supply chain communication process (Samuel Fosso Wamba, 2011). This way of viewing RFID technology in the supply chain highlights the strong bidirectional interdependency relationship concerning the adoption of the technology both by the early adopters and the late adopters. Clearly, the value of RFID systems data will increase as supply chain participants adopt RFID technology and get involved in the exchange of data across the supply chain network.

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