

The RFID Application in Logistics and Supply Chain Management

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Abstract: This study introduces the advantage of RFID technology in logistics and supply chain management and then lists the typical application such as dangerous goods track, container track, food surveillance and warehouse management. In addition, it analyzes the application scenario of RFID technology in logistics management field.

Key words: Radio Frequency Identification (RFID), logistics, supply chain management, tag, typical application

INTRODUCTION

The emergence of RFID (Radio Frequency Identification) technology has been greatly increased efficiency in the production process management, material flow management, logistics and transport, retail and distribution and other fields of the national economy industries, including electronic information industry. RFID may eventually replace the ubiquitous bar code in the future and become the main technology in logistics and supply chain management field (Singer, 2006).

Compared with the popular bar code technology, electronic tag has many advantages: omitting the manual control, waterproofing, antimagnetic, bearing the high temperature, a long service life and wide reading distance. Moreover, on the electronic label, data may encrypt, the storage capacity is big and the canned data can be changed. Thus, it has wider and more convenient application than the bar code. The popularization and the application of RFID will bring revolutionary changes to the retail and logistics industry.

The advantages of RFID technology make it have extensive application. In logistics management field, the RFID system can be applied to the cargo management of intelligent warehouse. It not only can process the cargo to go into storage, leave the storehouse and the stock management, moreover also can supervise and manage all the information about the cargo. At the same time, to introduce the RFID technology to the logistics management field, it can effectively save the artificial cost,

enhance the work's accuracy, guarantee the product quality, accelerate the processing speed. Moreover, the cargo with tags on them can effectively avoid being stolen, damaged or lost by using the read-write equipment in logistics management center.

THE ADVANTAGE OF RFID IN LOGISTICS MANAGEMENT

The RFID technology is a flow control technology. It can provide the strategic significant incremental benefit to the supply chain of manufacture, logistics, wholesale and retail industry. RFID industry can help enterprises increase the exchange quantity and accelerate the flowing speed of information to promote the efficiency and save the cost. In recent years, the RFID technology attracts so much attention. Experts in the industry analyzed reasons. First, global renowned chain commercial group Wal-Mart announced, from January, 2007, the biggest 100 suppliers of this group use the RFID technology to replace the popular bar code. Second, global code organization EPC global has published the standard specifications of product electronic code signal technology. All of these cause people enormously to favor the developing prospects of RFID technology.

Several large supplier and retailer have already adopted this new technology. Wal-Mart and the American Department of Defense display are typical examples. Wal-Mart requests its top 100 supplier paste the tag on all goods plate, the vessel, the box and the high

profit products before January, 2007. The American Department of Defense also set January 2007 as the deadline to request suppliers paste the tag. Although, there is serious commercial risk, suppliers have to accelerate the technical innovation and increase the investment. With the highly development of RFID technology, the price of the tag will greatly decrease. The last barrier that restricts the broad application of RFID technology will be eliminated. The companies which carry on early investment on RFID technology will hold big superiority to their competitors. This drives most of the company to research, develop and use this practical highly effective new technology.

Why can RFID cause the company to obtain rich profit? Mainly because it can reduce stock and the sales personnel cost, reduce labor cost of reading the code, reduce the goods in stock, reduces the occurrence of larceny and out of stock situation and so on (Biederman, 2006).

Reduce stock and the sales personnel aspect cost:

Generally speaking, for retailers, the stock and retailer cost will occupy 2-4% of their operation expense. The bar code recognition process which consumes much manpower can be replaced by using the read-write equipment to recognize the goods plate, the vessel, the box and the products. The RFID technology can reduce the number of sales person for >30%.

Reduce labor cost of reading the code:

The use of RFID product can help retailer reduce labor cost as well as regular cargo management and service fee of goods shelf. Through enhancing the self-service, reducing inspection time and mistake, the RFID product can greatly improve present inspection method of automatic scan.

Reduce the goods in stock:

The accurate stock list can reduce the occurrence of decreasing the book value intentionally. RFID can effectively reduce the stock mistake; highly promote the validity of stock report. Through, the use of RFID to track commodity accurately, the company can clearly grasp the sales historical record and enhance the accuracy of forecast of stock in need.

Reduce the occurrence of larceny:

For retailers, the loss of larceny reaches as high as 30 billion dollars, occupying at least 1.5% of total sales by conservatively estimation. By RFID technology, we can reduce loss of stock by tracking the commodity in supply system and finding the concrete position of commodity at anytime. The RFID technology has been applied successful in some stores, especially for the high profit or expensive goods.

Reduce the occurrence of out of stock situation: For retailers, the out of stock means making customers disappointed, or going to their competitors. Until now, the loss of out of stock is up to 4% of total sales, for food grocery. RFID technology can track the products, make clear stock list and forecast the supply-demand situation accurately. By this way, RFID can make stock volume reasonable. If retailers improve customers service and satisfaction degree, the sales volume will certainly largely increase.

Suppliers can write commodity style, origin, producer, product batch and other detailed information into the tag. When the cargo box with tag passes through the read-write equipment, the tag transmits the product data to the read-write equipment. Then equipment downloads the data to the central processor to generate the management database of product list. Thus, the total process from production, stock to sale can be clearly handled. The purchase, stock and delivery process will be more convenient. With RFID technology, the company also may realize the real-time monitoring on raw material, half finished product, end-product, transportation, stock, delivery, putting on the shelf and sales even returning the goods (Ames, 2004). By this way, the company can control the stock reasonably, realizing the intelligent management of logistics.

THE TYPICAL APPLICATION OF RFID IN LOGISTICS MANAGEMENT

Supply chain consists of all flowing process from raw materials to the final users. It includes choice of the suppliers, purchase of the materials, product design, material processing, order management, stock management, packing, delivery, store management and customer service, as well as the information management about product, product owner, location and time in the supply chain and so on. The purpose of RFID's application to supply chain is to facilitate the communication between suppliers and customers (Keskilammi *et al.*, 2003).

Successful logistics management can integrate all supply activity accurately and integrate all participants into supply chain. According to the different functions of the organizations, participants should include supplier, deliverer, transporter, third-party logistics company and information supplier.

The typical application of RFID in logistics management is tracking. Technically, we can stick tags on the plate, packing box or equipment to automatically save and transmit the style of the equipment, sequence number and other information. The tag can transmit the

information to read-write equipment distance away, so the equipment and end-product don't need to be scanned by the handset to read bar code in warehouse and workshop. This can reduce omission, promote efficiency greatly. This application model can reduce the cost and clean up barriers in supply chain. By the close integration into supply chains, RFID may replace the bar code technology in future.

The key of the modern logistics management is the automatically identification of product, container, vehicles and staff. Some information need to be transmitted and reflected real-time in MIS system and ERP system in the company. RFID can totally accomplish these functions, thus, it can be applied universally in the logistics management.

The application of RFID in the containers' tracking and management: The ultra-high frequency RFID technology has long identification distance, high speed to identify and low system cost. Thus, it is the best choice to tracking container and the plate.

The best way to transport large amount cargo is the container transport. Container transport has good privacy, good packing, low cost, strong compatibility to the entertainment, high transport density and standard piles buttress. Generally speaking, containers are supplied to the company which needs them by specialized container Transport Company. After the arrival and upload of the cargo, containers will be recycling. In containers' transporting and using process, the key link is tracking management, preventing the loss, larceny and damage of the containers; increase the turnover, so as to promote the use efficiency. To achieve the above goal, container transporting company needs to track containers in each link of the supply chain.

The application method of RFID recognition system in container management is to paste or mount the tags on the containers or the plates, through the hanging read write equipment or read-write equipment installed in the forklift or handset read-write equipment to recognize the dynamic information of the tags (Hook, 1997; Kremer, 1997). The information read can be transported to monitor or database. Container RFID recognition system can recognize 40 plates and 80 plastic containers simultaneously.

The application of RFID in tracking the fruit and other kinds of food: The supply chain of fresh fruits from the origin to the final customers can also use RFID to track, to guarantee the quality and nutrition of the fruit. Paste or mount the tags on the fruit boxes, until the fruits are consumed. Tags can be recognized be read-write

equipment and the information will be transmitted to monitor or database real-time. In the future, the household refrigerators will recognize the RFID tags of frozen food; remind you to buy fresh milk; throw off the expired food, decrease the consume of high Cholesterol food and so on (Kelepouris *et al.*, 2007).

Warehouse management: RFID can handle the information management about the cargo flowing effectively. Thus, it can enhance the cargo processing ability and the information amount of stock. Read-write equipment is set on door of the warehouse. Every cargo unit has RFID tags and all the information of the tags is in the central computer of the warehouse. When the cargo is out of the warehouse or transported, the read-write equipment can recognize and tell the central computer which trailer is working, which cargo is transported. By doing this, the management center can handle the amount of products going into storage and leaving storage, recognize cargo and determine the locations to track the products.

In logistics management, the key technology is tracking the goods. RFID is very popular in the field of logistics management abroad. With the development of RFID and the decreasing cost, RFID system will be become more and more popular globally (Field, 2005).

THE APPLICATION PROCESS OF RFID IN LOGISTICS MANAGEMENT

Although, logistics is one of the application areas of RFID, if RFID technology closely integrated into every process of supply chain, it may replace bar code technology in very near future and take revolutionary changes to logistics management (Fish and Forrest, 2005).

Purchase, stock, packing, handling, transporting, delivery, processing, distribution, sales and service are all business links and process of logistics chain. They are complementing one another and mutually restricted. Corporations must understand and handle the commercial flow, logistics, information flow and cash flow's directions and changes in all links of logistics accurately and real time. So that, the flow of the 4 segments, each process are coordinated with each other, only by this way corporations can maximize the potential economic and social benefits (Fish and Forrest, 2006; Loebbecke, 2007; Wamba *et al.*, 2006; Koroneos, 2006). However, as the actual objects are moving, all sectors are in a loose and moving state. Accordingly, information often changes with the movement of object in different time and space. It affects the availability and sharing of information. Fortunately, RFID is the new technology in logistics

management, which can solve the problems in data input/output, process control and tracking, reduce the error frequency (Tan and Raguraman, 2006).

RFID plays a crucial role in many areas of logistics, including retail, stock, delivery and distribution process.

Retail process: Through effective transport and inventory tracking, retailers can improve inventory management and timely replenishment, improve efficiency and reduce errors. Meanwhile, Tags monitor commodities with certain validity period and quality period; shops can use RFID system for automatic scanning and billing to replace the inefficient means of artificial collection.

In the next few years, RFID tags will be widely used in terminal sales process in supply chain. Particularly in supermarkets, tags are capable of producing highly accurate business data by removing manual intervention. So it has a huge attraction. Currently, the world's retail giant Wal-Mart is making full use of RFID technology, eliminating the use of the bar code, to further enhance the efficiency of the retail chain (Jiang-Liang and Chih-Hao, 2006; Hamdan *et al.*, 2006).

Storage process: In the warehouse management, RFID technology is usually used to store the goods and take stock inventory and operate goods in and out of stock automatically. Throughout, the warehouse management, combining receipt, collection, shipment plan set up by the supply chain planning system to RFID system (Glidden *et al.*, 2004), it can complete all kinds of business operations with high efficiency, as designating storage areas collection and supplementary supply. RFID technology can increase the accuracy and operating fast, significantly improve service quality and reduce operating costs, save inventory space and labor cost by reading code. It could also reduce the overall loss due to the misplacement, wrong sending, theft, damage and inventory shipment error. RFID can provide the accurate information of the inventory, thus, management staff can quickly identify and correct operational ineffective situations to achieve rapid supply and reduce storage costs as much as possible (Imburgia, 2006).

Delivery process: In delivery management area, we can paste RFID tags to transporting cargo and vehicles (such as to containers and to equipments) to track and control. RFID read-write device is usually installed in transport lines in some checkpoints (e.g., doorpost or bridge pier) and warehouse, stations, docks, airports and other key locations (Nemeth *et al.*, 2006). When the read write device receives the information from tags, it will convey the information with

location data to the communication satellite, then satellite will transmit information to transport dispatching center.

Distribution process: In distribution, introduction of RFID technology can greatly accelerate the speed of delivery, improve efficiency and accurate rate of selection and distribution process and reduce the probability of artificial participation and reduce distribution costs (Michael and McCathie, 2005). When all goods pasted with RFID tags enter distribution center, through the read write equipment on the door, the plate can read the information of tags. The system will compare the information to sender record, to detect possible errors and then update the location and state information on tags. This will ensure accurate inventory control, or even to master exactly cargo box volume, transshipment of origin and destination, as well as the expected arrival time and other relevant information.

CONCLUSION

RFID technology makes product inventory control and intelligent logistics technologies realizable. With the help of tags, the company may realize the real-time monitoring raw material, half-finished product, end-product, transportation, stock, delivery, putting on the shelf and sales even returning the goods. For instance, through RFID technology, the operator can immediately know the situation and do rapid replenishment, to reduce 10-30% safety stock and storage costs. It will make the whole logistics management transparent and efficient by increasing the automation and decreasing error rate. RFID technology is widely applicable to the storage shelves, transportation management, material tracking, delivery vehicles, supermarkets and other requiring non-contact data collection and exchange occasions.

REFERENCES

- Ames, B., 2004. RFID tracking brings new challenges to logistics. *Military and Aerospace Electronics*, 15 (11): 358-366.
- Biederman, D., 2006. RFID gains ground in logistics. *J. Commerce*, 7 (8): 36-37.
- Field, A., 2005. Mixed RFID Signals. *J. Commerce*, 3: 15-18.
- Fish, L.A. and W.C. Forrest, 2005. The State of RFID Implementation: Changing the Way We Do Business. Proc. 36th Annual Meeting of the Midwest Decision Sci. Institute Annual Meeting, pp: 14-16.
- Fish, L.A. and W.C. Forrest, 2006. A Comparison of Retail RFID Implementation Around the World. Proc. Decision Sci. Institute Annual Meeting, pp: 18-20.

- Glidden, R., C. Bockorick, S. Cooper and C. Diorio *et al.*, 2004. Design of ultra-low-cost UHF RFID tags for supply chain applications. *Commun. Mag. IEEE.*, 42 (8): 140-151.
- Hamdan, A., C. Man and K.J. Rogers, 2006. RFID Application in the Third-party Logistics Industry. *Technology Management for the Global Future (PICMET)*, 6: 2769-2795.
- Hook, C., 1997. RFID applications in manufacturing and logistics. *News Europe*, 6 (8): 37-39.
- Imburgia, M.J., 2006. The Role of RFID within EDI: Building a Competitive Advantage in the Supply Chain. *Service Operations and Logistics and Informatics (SOLI)*, pp: 1047-1052.
- Jiang-Liang, H. and H. Chih-Hao, 2006. Quantitative performance evaluation of RFID applications in the supply chain of the printing industry. *Industrial Management and Data Systems*, 106 (1): 96-120.
- Kelepouris, T., K. Pramataris and G. Doukidis, 2007. RFID enabled traceability in the food supply chain. *Industrial Manage. Data Syst.*, 107 (2): 183-200.
- Keskilammi, M., L. Sydänheimo and M. Kivikoski, 2003. Radio Frequency Technology for Automated Manufacturing and Logistics Control. Part 1: Passive RFID Systems and the Effects of Antenna Parameters on Operational Distance. *Int. J. Adv. Manufacturing Technol.*, 21 (10): 769-774.
- Koroneos, G., 2006. RFID and the Future of Pharmaceutical Supply Chains. *Pharmaceutical Technol.*, 30 (5): 28-30.
- Kremer, K., 1997. RFID in distribution logistics just what the chemist ordered. *News Europe*, 6 (9): 30.
- Loebbecke, C., 2007. Piloting RFID Along the Supply Chain: A Case Analysis. *Electronic Markets*, 17 (1): 29-38.
- Michael, K. and L. McCathie, 2005. The pros and cons of RFID in supply chain management. *Int. Conf. Mobile Busin.*, pp: 623-629.
- Nemeth, P., L. Toth and T. Hartvanyi, 2006. Adopting RFID in supply chains. *IEEE. Int. Conf. Mechatronics*, pp: 263-266.
- Singer, T., 2006. RFID and Logistics: 4 Trends You Need to Know. *Industrial Maintenance and Plant Operation*, 67 (9): 18-19.
- Tan, L.L. and K. Raguraman, 2006. RFID Centre Tests Live Supply-Chain Application (cover story). *Innovation*, 6 (1): 28-31.
- Wamba, S.F., Y. Bendavid, L.A. Lefebvre and E. Lefebvre, 2006. RFID technology and the EPC network as enablers of mobile business: A case study in a retail supply chain. *Int. J. Networking and Virtual Organisations*, 3 (4): 450-462.