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RFID APPLICATION IN THE SUPPLY CHAIN

ABSTRACT

This paper analyses the possibilities and ways of utilizing RFID as a tool for more effective supply and logistics chain management. It focuses on RFID technology used within and across logistics processes and it looks to RFID as one of the possibilities for automating logistics processes. The benefits and implications of RFID technology implementation in the supply chain are illumined.

KEY WORDS

RFID technology, supply chain, tracking and tracing of products

1. INTRODUCTION

The number of changes and new products has increased; at the same time the increased complexity of the supply chain is occurring as a result of globalization, the expansion of markets, outsourcing of production and services, etc. The results are increased demands on delivery reliability and flexibility. The pressure on inventory therefore has increased significantly, partly because inventory management is labour intensive, difficult, and prone to errors under current practices. Consequently, automation of the inventory management presents one of the biggest logistics challenges in the supply chain.

The identification of products is of prime importance to the logistics sector, an imperative condition of the tracking and tracing of goods throughout the supply chain. Tracking technologies such as GPS and RFID technologies are becoming an indispensable part of the IT infrastructure and business solutions of every participant in the supply chains. RFID technologies are therefore being adopted by (big) manufacturing, warehousing, and distribution firms that worry about delivering the right items to the right location at the right time. RFID lets companies know exactly which item is in which truck or other transport means and when it arrives at which warehouse.

Typical applications of RFID include the labelling of products, inventory tracking, animal tagging, the timing of marathon runners, securing automobile keys, and controlling access for the security of facilities. Inventory tracking is now necessary to an unprecedented degree in order to support the growing consumer markets at low operating costs and to remain price-competitive despite the relatively high labour cost in developed countries.

2. AN OVERVIEW OF RFID TECHNOLOGY

RFID (Radio Frequency IDentification) is an electronic tagging technology that allows an object, place, or person to be automatically identified at a distance without a direct line of sight, using an electromagnetic challenge/response exchange. [9] The capability of saving a large amount of digital information in a minuscule chip offers the opportunity of tracing a product during each step of the supply chain, as well as collecting and accessing information about this product.

An RFID system (see Figure 1) is composed of readers and tags. Readers generate signals that provide power for a tag and create an interrogation signal. A tag captures the energy it receives from a reader to supply its own power and then executes commands sent by the reader. The simplest command results in the tag sending back a signal containing a unique digital ID number. Tags are read by readers that do not need line of sight or human intervention, just to be within range.

RFID allows an unprecedented degree of information sharing throughout the supply chain. Each RFID tag contains a unique electronic product code (EPC), which is the key to all of the information about the tagged product (what it is, when it was made, where it has been, etc.). This information is stored in a central location (database), sent to partners in the supply chain, or both, so that anyone who needs to access the information can get to it via the internet.

But implementation of RFID throughout the supply chain is a complex job. RFID must be deployed not only internally, but rather in a standardized and synchronized manner across the entire supply chain, also by retailers, manufacturers, third-party logistics providers, co-packers, and packaging and display manu-
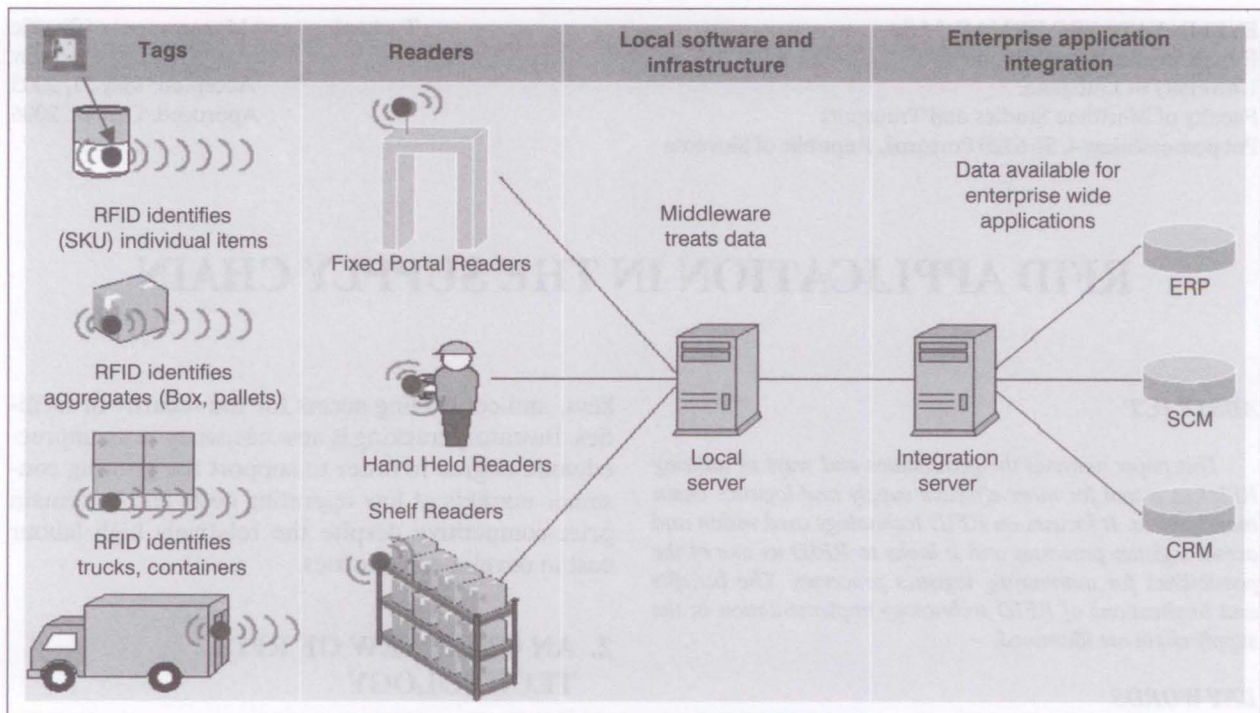
Figure 1 - RFID system [1]

facturers. It requires the creation and adoption of industry-wide standards, integration with internal business systems and information communication technology, not to mention a significant investment in RFID tagging and reading equipment and a supporting technological infrastructure (on the shopfloor, in warehouses and distribution centres, and over the internet). RFID is a business strategy, not only an IT strategy. It involves the transformation and adaptation of business processes, market positioning for sales forces, and collaboration with customers, retailers, other supply chain partners, and third-party service providers. [8]

3. RFID TECHNOLOGY IN THE SUPPLY CHAIN

The supply chain is a complex multi-stage process that involves everything from the procurement of raw materials used to develop products and their delivery to customers via warehouses and distribution centres. A supply chain exists in service, manufacturing and retail organizations. The complexity of supply chains can vary greatly from industry to industry and from firm to firm. Supply chain management (SCM) can be seen as the supervision of information and finances of these materials as they move through different processes by coordinating and integrating the flows within and among the different companies involved.

The efficiency of the supply chain has a direct impact on the profitability of a company. This is the rea-

son many large companies have made it the key part of their strategy, and invested a lot in software systems, like ERP (Enterprise Resource Planning System), WMS (Warehouse Management Systems), etc., in addition to IT infrastructure designed to control inventory, track products and manage associated finances.

RFID could deliver a new dimension to supply chain management by providing a more efficient way of identifying and tracking items at various stages throughout the supply chain. It enables the automatic capture of product data, which therefore is more quickly available for use by other processes such as advanced shipping notices (ASN), stock management and real-time billing.

Key actors of the supply chain, namely manufacturers, logistics service providers and retailers, have different perspectives on RFID potential despite the fact that they have an interest in common activities – cross-supply chain activities - in order to trace a product through the supply chain or to provide each other forecasts on consumption, etc. Table 1 shows activities in which key supply chain actors are interested (as their primary activities) and different application areas for RFID and levels of identification of their interest.

4. AUTOMATION OF THE SUPPLY CHAIN

The integration of RFID technology in various processes in the supply chain that we can automate

Table 1 - Activities and application areas of interest for key supply chain partners

supply chain key actors or partners	activities of interest	RFID application areas
manufacturers	producing (primary activity), value of warehouse activities of raw material and finished goods, value of transportation to clients	tracing of raw materials and tagging finished goods; truck products at the pallet and case level (monitoring the product flow)
logistics service providers	distribution activities: warehouse management, transportation	tracing of products at the level of the smallest transportable unit (pallet, parcel, unit) linked to the returnable transport items (RTI) - monitoring the product flow
retailers / / distributors	management of its own distribution centres, transportation stores, store activities	tracing of product flows at the item and crate level; tracing of returnable transport items

makes supply chain more efficient and reduces operating costs.

At the manufacturer site (product-assembly packaging line): Each item contains an RFID tag with a unique identifier called an EPC (Electronic Product Code) stored in its memory. Items can be automatically and cost-effectively identified, counted and tracked. Cases and pallets can also carry their own unique tags. As pallets leave the manufacturer, an RFID reader positioned at the loading dock door
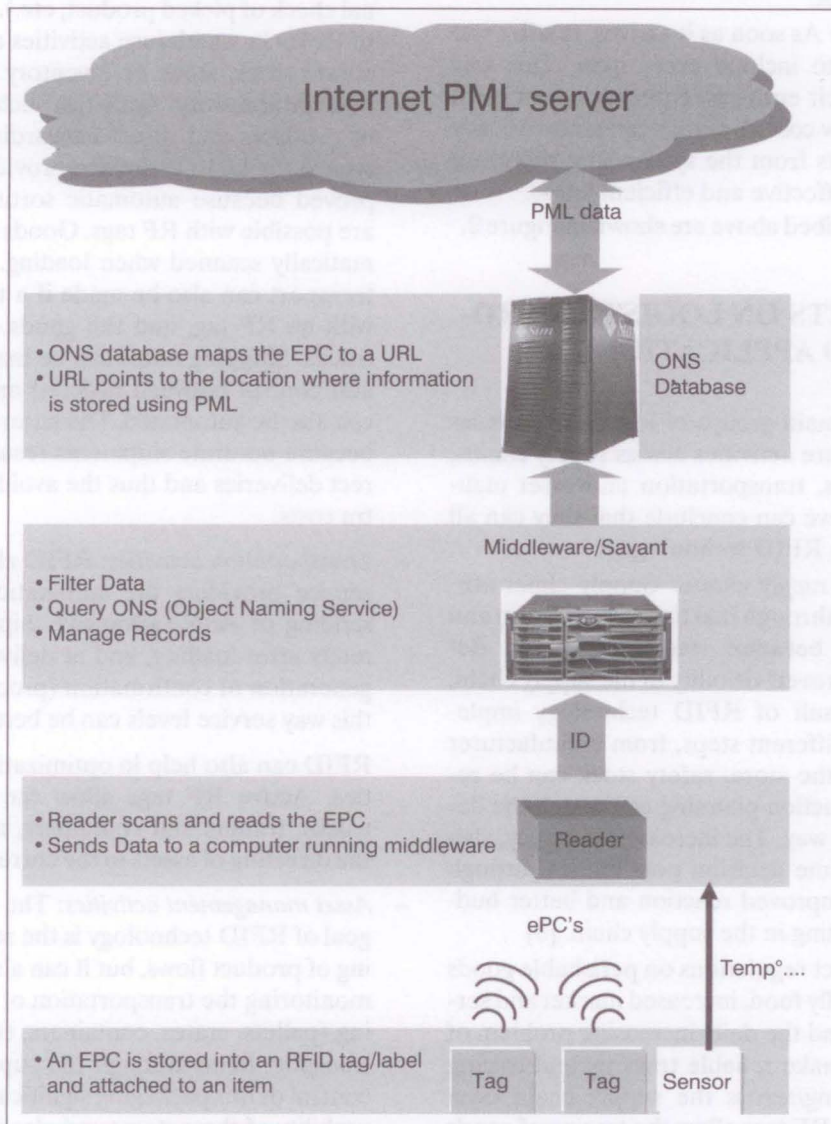
Figure 2 - Basic steps of EPC infrastructure. [1]

beams a radio wave that wakes up the tags. The tags communicate their individual EPC to the reader, which rapidly switches them on and off in sequence (an anti-collision measure), until all are read. The reader sends the EPC to a computer that in turn sends the EPC over the internet to a special database (Object Naming Service - ONS), which produces a corresponding address. The ONS matches the EPC to another server (PML - Physical Markup Language), which has full details about the product. The PML server stores details about the manufacturers' products. Because it knows where the product was made, if an accident involving a defect arises, the source of the problem can be tracked and the products immediately recalled.

At the distribution centre: If the unloading area contains an RFID reader, there is no need to open the packages and examine their contents. The computer provides a cargo list, and the pallet is quickly routed to the appropriate truck.

At the retail store: As soon as it arrives, retailer systems are updated to include every item. This way stores can locate their entire inventory automatically, accurately and at low cost. A reader can automatically order more products from the system and therefore keep stock at cost-effective and efficient levels.

Basic steps described above are shown in Figure 2.

5. RFID IMPACTS ON LOGISTICS PROCESSES AND APPLICATIONS

Analyzing four main groups of logistics processes or activities, which are activities across supply chains, warehouse activities, transportation and asset management activities, we can conclude that they can all benefit greatly from RFID technology.

– *Activities across supply chains:* Supply chain efficiency increases through real time cooperation and communication between trading partners. Because of the improved visibility in the supply chain, which is the result of RFID technology implemented in the different steps, from manufacturer to inventory in the store, safety stock can be reduced and production planning can match the demand in a better way. The increased accuracy, visibility and real-time decision possibilities through RFID lead to improved reaction and better budgeting and planning in the supply chain. [8]

Today's very strict regulations on perishable goods security, especially food, increased market and service demands, and the daily increasing problem of theft or fraud, make reliable tracking and tracing of products along/across the supply chain even more necessary. RF tags allow the tracing of goods at the item and pallet level and offer an enormous amount of information about individual products, groups of products, product modifications, inventory modifications, shipment, etc. By using RFID technology at various points in the supply chain, then, authenticity and product quality can also be guaranteed.

– *Warehouse activities:* RFID offers numerous advantages at the point of the receipt of goods because the goods can be scanned when they are unloaded from the truck and automatically linked to product and delivery information. Manual labour is reduced and accuracy of data input and tracking are improved. The only condition that has to be satisfied is that pallets, packaging or products are equipped with RF tags. Manual errors at put-away, restocking and picking of goods can be further reduced in warehouse processes and an improved flow of products is possible. A number of manual processes can even be excluded (cycle counting, final check of picked product, etc.). Implementation of RFID in warehouse activities also results in accurate stock, stock or inventory visibility and labour productivity. Activities such as the grouping of products and direct forwarding to customers, typical for logistics service providers, are also improved because automatic sorting and grouping are possible with RF tags. Goods can also be automatically scanned when loading. The link during transport can also be made if a truck is equipped with an RF tag, and the goods can be linked to trucks. Shipping notes can be made automatically and control between ordered and shipped items can also be automated. The latter is very important because accurate shipments result in fewer incorrect deliveries and thus the avoidance of some extra costs.

– *Transportation activities:* RFID allows the logistics service providers the automatic generation and sending of ASN (advanced shipping notices) directly after loading, and at delivery an automatic generation of confirmation (proof-of-delivery). In this way service levels can be better controlled.

RFID can also help in optimization of yard activities. Active RF tags allow the management of trucks, trailers and containers, and consequently the directing of assets to the correct loading docks.

– *Asset management activities:* The primary usage or goal of RFID technology is the real-time monitoring of product flows, but it can also be valuable for monitoring the transportation of reusable packaging (pallets, crates, containers, etc.) or returnable transport items through the supply chain. Easier control of this packaging significantly increases the usability of these items and also improves the efficiency of asset management.

6. SUMMARY OF THE MAIN BENEFITS AND ADVANTAGES OF RFID IN THE SUPPLY CHAIN

The demands for RFID are apparent in general business elements such as the need for the reduction of operating costs and the improvement of services. As regards studies conducted by the Flanders Institute for Logistics [8] and others, an overview of the logistics areas or supply chain management problems with the highest RFID-use potential is provided in the following paragraphs.

– The fact is that power is shifted at the end of supply chains. Consequently, retailers demand additional traceability from their suppliers.

– Customers can benefit, because retailers that use RFID technology can provide detailed information to them on items in their stores, allowing them to be more informed about the items they are purchasing. Since RFID reduces the cost of managing inventory, the consumer or customer will benefit from the resultant lower prices.

– The generation of advanced shipping notices (ASN) is automatic. RFID can automatically detect when either a pallet or shipment has left the warehouse or distribution centre and this not only allows the generation of an electronic ASN (ASN information is obtained from the RFID tag) and notification of the recipient, but also to bill clients in real-time instead of waiting until the end of the week or month, and doing a batch operation.

– The supply chain is more market and demand driven - throughput speed, flexibility and reliability of deliveries need to increase.

– Pressure to improve stock management and to abolish two of the greatest disadvantages of inventories, which are high costs and the obsolescence of products, are high. With RFID this is possible by reducing lead times of information through faster and more reliable registration, by fine-tuning plans and increasing visibility in the supply chain; uncertainty is reduced, which leads to inventory level reduction. Improved stock management is one of the key priorities for many retailers. Implementing RFID at the item level and on shelves will provide an automatic way of knowing and managing stock levels.

– Increased regulation and legislation, environmental and quality demands lead to higher visibility and traceability, and more product information (the origin of each food product needs to be known at every step across the supply chain).

– Reduction of costs and the demand for increased efficiency is present. Labour costs have to be cut; improvements in productivity and efficiency have to be made. This is possible through new technologies and by automating logistics processes; i. e., removing the need for manual intervention and the use of barcodes when loading cases or stocking pallets.

– Synchronization, connectivity and visibility in the supply chain are of great importance. The most important condition for the success of logistics service providers is their ability and possibility of communicating with their trading partners. RFID enables traceability and reduction in the number of discrepancies between what a supplier invoiced, and what a customer actually received.

– Companies do not want to lag behind other market players or to lose their competitive advantage.

– Product loss or shrinkage and theft are two of the major problems in the supply chain that result in decreased sales. The causes can vary from misplaced orders, employee and customer theft to inefficient stock management. The tracking and identification capabilities of RFID offer a good means of determining where losses are occurring.

– Electronic sealing through RF-tags can guarantee the authenticity and origin of the product and also offers a way to prevent the illegal duplication and manufacture of high-value products.

The possible advantages of implementing RFID technology in the supply chain are various and so are the points of its implementation in the supply chain and levels of tagging. Some of the most valuable results of RFID implementation are certainly:

– increased inventory visibility, accuracy and velocity, stock-out reduction,

– automation of actions,

– replacement of current system of identification,

– limiting errors in actions by reduction of labour requirements,

– increased service to customers (shorter order lead times, shipment leading times, better order fill rates, etc.),

– reduced administration and administrative errors,

– new modes of trade with suppliers,

– reduction of delivery and other errors,

– increased plant capacity,

– increased efficiency,

– better control of assets (safety and quality control) and

– better prevention of fraud and protection of property.

7. CONCLUSION

RFID technology is still relatively new and creates some problems for end users; for instance, the prob-

lem of effective integration of RFID data with backend firms' systems is still very big, tags are still too expensive, there is a lack of agreed-upon standards, RFID technology is changing daily, RFID deployment is complex and expensive, etc. In spite of all this, it is undoubtedly a very promising technology, a technology that will revolutionize and transform supply chains. It will also be an elemental condition of doing business in the near future. It is radically changing the competitive landscape of packaging, manufacturing, logistics, and retailing. One of the biggest advantages of RFID technology is that it allows data collection at many points in each supply chain process. One of the results of the collection of this data is a large amount of historical data related to warehouse receipts, shipped goods, components used in the manufacturing process, manufactured goods, goods received at the customer site, in-store sales, etc. This data can be used in decision processes and processes of improvement of business systems. RFID technology also offers a new way of doing business and communication with supply chain partners. RFID is a technology that can provide considerable value in a world in which operating costs are often dominated by labour time. And it is an exciting technology that can change the way we interact with the world. It also offers a way to retain control of the supply chain—to know who, what, when, where, why and how at every instant in time for every item in the supply chain.

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POVZETEK

UPORABA RFID TEHNOLOGIJE V OSKRBNI VERIGI

V članku so analizirane možnosti in načini uporabe radiofrekvenčne identifikacije kot orodja, s katerim je mogoče izboljšati upravljanje oskrbne in logistične verige. Poudarek je na avtomatizaciji procesov oskrbne verige s pomočjo RFID tehnologije. Predstavljene so tudi posledice in prednosti implementacije RFID tehnologije v oskrbno verigo.

KLJUČNE BESEDE

RFID tehnologija, radiofrekvenčna identifikacija, oskrbna veriga, sledenje izdelkom

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