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Simulation of Implementing RFID in Supply Chain Management

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Abstract: This paper discusses the implementation of Radio Frequency Identification (RFID) in Supply Chain Management (SCM) to control inventory, tracking of object, supply chain management in warehouses, stores, etc. and benefits of RFID Technology. Various RFID systems can be obtained by combining different tags, readers, frequencies and levels of tagging, etc.

I. Introduction

The traditional supply chain consists of all the parties involved directly or indirectly in fulfilling a customer request, including manufacturers, suppliers, transporters, warehouses, retailers, and the customers themselves, as we can see in Fig.1.

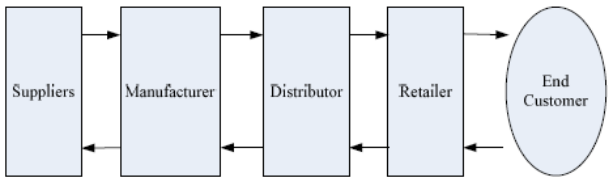

Figure 1 the structure of the traditional supply chain

The main goal of each member within the supply chain is to reduce unwanted inventory levels and increase ROI (Return on Investment). This is reduced by implementing RFID in SCM.

A basic RFID system includes a radio frequency tag, a combination of a microchip and an antenna, and a reader. The reader emits electromagnetic waves, which are received by the tag's antenna. The tag sends the data, which is usually a serial number stored on the tag, by transmitting radio waves back to the reader.
Its ability for real-time identification and tracking over considerable distances without line-of-sight technology requirements. Other major benefits of RFID in SCM include labor reduction throughout the supply-chain network and better inventory management that can yield significant cost savings and improved data collection with greater accuracy.

II. RFID Technology

RFID is a generic technology concept that refers to the use of radio waves to identify objects. RFID tags have both a microchip and an antenna. The microchip is used to store object information such as a unique serial number. The antenna enables the microchip to transmit object information to a reader, which transforms the information on the RFID tag to a format understandable by computers. The RFID is considered a significant improvement over the conventional barcode, which needs to be read by scanners in "line-of sight" fashion and can be stripped away if the paper product labels get ripped or damaged.

A. RFID Tags

Current RFID tags can be active, passive, or semi-passive. Active RFID tags use a battery to power the microchip's circuitry and broadcast signals to the reader. Passive tags do not have batteries and are powered by the electromagnetic waves sent out by a reader to induce a current in the tag's antenna. Semi-passive tags use both the battery and the waves sent out by the reader. Active and semi-passive tags are typically used for higher-value goods that are scanned over longer distances. Some newer tags also have anti-collision features (many tags can be read even if they are located in the same small contiguous area). The chip in the tag is either read-write or read-only. Information can be embedded in read-write chips, which are far more expensive and are used for higher-value product items. Read-only chips are more commonly used for tracking inexpensive items. A major issue with the RFID tag is keeping costs down to encourage wider scale adoption. At this time, the most inexpensive tags cost 50 cents each in very large quantities. It can be bring down the cost to about 5 cents per tag or lower by

using different methods such as shrinking the size of the chip itself and cutting the costs of the antenna.

B. RFID Reader

Through the method of inductive coupling,
RFID readers communicate with tags. The coiled antenna of the reader creates a magnetic field with the tag's antenna, which subsequently draws energy from this field and uses this to send back waves to the reader. These waves are transformed into digital information representing the Electronic Product Code (EPC). The "read range" of the tag depends on both the reader's power and the frequency used to communicate. Higher frequency (850 MHz to 950 MHz) RFID readers can read from longer distances but require more energy; therefore, they tend to be more expensive. Conversely, lower frequency (30 KHz to 500 KHz) RFID readers are less expensive but they do have shorter reading ranges. The antenna of reader puts out radio-frequency (RF) signals. The RF radiation does two things; it provides a means of communicating with the tag (the RFID chip) and (in the case of passive RFID tags) it provides the RFID device with the energy to communicate. The information transmitted in the form of RF can be codified and modulated. When an RFID tag passes through the field of a reader's antenna, tag's antenna detects the activation signal from the reader's antenna. The RF radiation activates the tag chip, which in turn will execute the commands from the reader; either it will write information on memory or it will transmit the information on its microchip to be picked up by the reader. The information received by the reader will be demodulated and de-codified and sent to the company database through a middleware.

C. RFID Middleware

RFID Middleware is the interface needed between the RFID reader and the existing company databases and other information management software to move data read by the RFID readers to company database. It consists of computer hardware and data processing Throughout the warehouse management, receipt plan, picking up plans and shipment plans of supply chain planning systems combined with RFID technology can and cost and inventory are reduced and also labor is saved. At the same time, the loss of the overall logistics due to the misplacement of goods, theft, damage, and shipping errors is also reduced. In transport management, because the vehicles and goods are all software connected to enterprise inventory or identification management systems. A middleware platform provides the operating system, data repository, and processing algorithms that convert multiple tag inputs into visible tracking or identification data.

III. Modeling & Simulation SCM

As mentioned earlier, using RFID technology, the efficiency of supply chain management will be enhanced greatly. Keith et al., predict that receiving check-in time could be reduced by 60%-93% with RFID technology [10]. It is also estimated that RFID could yield labor savings of up to 36% in order picking and a 90% reduction in verification costs for shipping processes [8]. Enhanced visibility is also one of the greatest benefits from RFID technology.

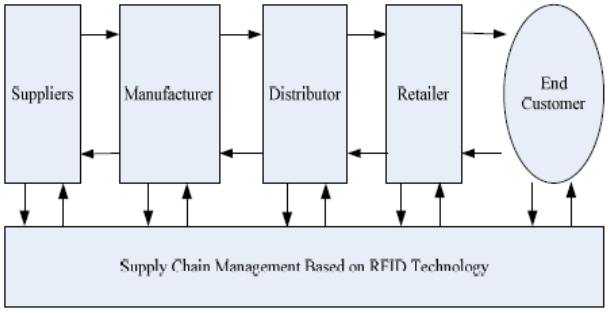

Figure 2 the structure of RFID-based Supply chain

As an example, we can see in Fig.2. The whole process of the supply chain can be divided into several processes, such as retail process, store process, transportation process, distribution process, and producing process, etc.
During the retail process, RFID can improve the retailer's inventory management; enable the retailers to replenish goods in time, track transportation and inventory efficiently, improve efficiency, and reduce errors, etc. In the warehouse, RFID technology is usually used in the process of the access of goods and inventory.

efficiently complete a variety of business operations. Thus, accuracy, service quality and operations are all enhanced,
attached with RFID tags, when they pass through some checkpoints, information stored in tags can be captured by the readers. Then, the information and the location of the goods are all uploaded to the communication satellite, and after that transmitted by satellite to the

transportation dispatch center and stored into the database at last. During the distribution process, using RFID technology can greatly accelerate the speed of delivery, improve the efficiency and accuracy, reduce labor and costs, and ensure accurate inventory control, or even know exactly how many containers are in transit, origin and destination of transshipment, and the expected time of arrival, etc. Likewise, using RFID technology in the manufacturing process can complete the operation of the automated production lines, realize the identification and tracking of raw materials, components, semi-finished and finished product in the whole production line, reduce labor costs and the recognition error rate, and also improve efficiency. RFID technology can not only help managers to send replenishment messages in time according in order to production schedule to achieve a balanced line and steady production, but also strengthen the control and tracking of quality.

IV. RFID Benefits

There are several benefits if it implements:

A. Cost Reduction

Implementing of RFID technology reduces the cost of labor and decreases the time taken for order-picking, receiving, etc. Suppose if we use bar code in warehousing for receiving goods we have to move to pick location, scan the tag, check digit, and pick up again, place the case on the pallet. From above some of the steps can be eliminated such as scanning and handling by implementing RFID technology.

B. Data Accuracy

RFID technology reduces the checking, rechecking or verifying the correct product & quantity. It gives absolute identification of exact product & quantity and eliminates the manual operation error. These enhance the accuracy and satisfy the customer.

C. Product Tracking

Using RFID technology we can follow the moment of our product so that we can know where it is and when it will reach.

D. Inventory Planning

RFID technology increases visibility of inventory with accuracy and reduces the cost.

E. Theft Control

RFID technology prevents from thieving of products by tracing any unauthorized moments of product.

V. CONCLUSION

The main purpose of this paper is to study the application of RFID technology in supply chain management and improve the efficiency by tracing the object.

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