



## HOW RFID TECHNOLOGY BOOSTS WALMART'S SUPPLY CHAIN MANAGEMENT

Sandy Kosasi, SE, MM, M.Kom<sup>1</sup>, Dr. Hoga Saragih, ST, MT<sup>2</sup>

STMIK Pontianak<sup>1</sup> & Bakrie University<sup>2</sup>

Email: <sup>1</sup>[sandykosasi@yahoo.co.id](mailto:sandykosasi@yahoo.co.id) & <sup>2</sup>[Hogasaragih@gmail.com](mailto:Hogasaragih@gmail.com)

### Abstract

*Purpose – The role of RFID technologies in supply chain management have gained significant interest in researchers and academics in recent years. Yet, very few studies conducted on how this technology could boost supply chains. So this study was to scrutinize how RFID technology boosts Wal-Mart's supply chain management. Design/methodology/approach – Exploratory research approach was adopted to obtain an in-depth understanding of RFID technology and supply chain through related journals and literatures. Then the research was conducted in the form of case studies on RFID technology and Wal-Mart's supply chain management practices. In general, the research is more descriptive and interpretive in nature. Findings – Wal-Mart succeeded in adopting the RFID technology, reduced out-of-stocks and the bullwhip effect, reduction in manual orders resulting in a reduction of excess inventory, improved service levels and reduced administration costs. Originality/value – The paper is original that provides empirical support to RFID and SCM implementation, and creates value for retail stores on managing inventory.*

**Keyword: RFID, SCM, Bullwhip Effect, VMI, CPFR**

### INTRODUCTION

Most retail stores are facing inventory problems because of bullwhip effects and the lack of real-time product and data for retail stores. These issues would affect product receiving labor costs and paperwork, lost sales due to out-of-stock, incorrect inventory and misplacements, dated point-of-sale data for planning, proper management of date sensitive inventory, check-out station labor and times, product shrinkage (theft) and return frauds, and product return.

Radio Frequency Identification (RFID) is emerging as a technology that could provide the answer to these problems. Since this technology is providing companies with ways to become faster and more efficient in all areas of the supply chain, from the original equipment manufacturer down to the end consumer. RFID Technology is a smarter way to track shipments, time deliveries, and keep inventories; this in turn makes processes faster, more efficient, and with less error. It goes beyond other systems because it encompasses more information than prior technologies.

Using tags, readers and radio waves to communicate between the two, RFID combined with the EPC (Electronic Product Code) would be able to address these pain points and deliver a whole range of benefits across various verticals like manufacturing, distribution, retail, and logistics. The potential benefits arise from increase in supply chain visibility, increase in efficiencies and decrease in costs due to better data synchronization, increase in responsiveness to changes due to real time information visibility. Thus, RFID promises to have a major impact on supply chains allowing trading partners to collaborate more effectively and achieve new levels of efficiency and responsiveness. Realizing the potential of RFID to deliver major benefits in the supply chain, both end users and technology vendors are moving quickly to harness its potential. RFID enables Wal-Mart to improve the efficiency of its supply chain management through greater supply chain visibility and more accurate ordering decisions. Just in Time (JIT) ordering enables Wal-



Mart to decrease the costs associated with inefficient inventory decisions and handling. Ordering and sales are more closely aligned, decreasing the intensity of Bullwhip effects.

This study explored the role of RFID in Wal-Mart's supply chain for obtaining information; RFID technology and the supply chain, components of RFID, the integration into the supply chain, the benefits, and how it can boost and enhance Wal-Mart's supply chain management. Potential benefits against inventory inaccuracy problems, the bullwhip effect, vendor-managed inventory, and replenishment policies are the main topics that this study focused on. A brief survey of potential benefits of RFID technologies in supply chains is presented in three parts; (1) the benefits of RFID improving inventory accuracy, (2) dealing with the bullwhip effect and (3) replenishment policies in supply chains.

## LITERATURE REVIEW

### RFID Definition and History

RFID is a technology that enables large amounts of information to be stored on chips (tags/transponders) that can be read at a distance by readers, without requiring line of sight scanning [12]. RFID is considered superior to barcodes because of their ability to track and monitor and improved efficiency of its incoming goods and inventory processes. It is also significant time savings in the incoming goods receiving process because employees no longer have to manually count items or scan their bar codes to find out if an order was complete. Once the RFID tags are applied, employees save significant time by no longer having to attach and detach electronic article surveillance (EAS) security tags and take inventory. The RFID system then reads the EPC number encoded to the item's RFID tag, and removes it from the database. Wal-Mart is encouraging all companies with which it does business to take advantage of its tagging, in order to improve their processes and services by implementing RFID read points in the supply chain, or at other points.

RFID is a valuable technology for tracking inventory in the supply chain. It can synchronize information and physical flow of goods across the supply chain from manufacturers to retail outlets and to the consumers at the right place at the right time. Likewise, RFID can track returned goods through the supply chain and prevent counterfeit. It

also helps to reduce out-of-stock items. There is no doubt that RFID is invaluable for improving inventory management and supply chain efficiency [12]. Wal-Mart has mandated the use of RFID technology by its top 100 suppliers at the level of product cases. Full implementation of RFID could eliminate the need for manual counting and barcode scanning at the receiving dock [7]. RFIDs have tremendous opportunities for increasing value to a firm by providing increased product visibility, reduce out-of-stock items, trim warehouse costs, eliminate stock errors, reduce theft and shrinkage and allow companies to regularly update their logistics and inventory databases [4]. Wal-Mart's performance improvements represent major benefits of RFID--efficient tracking of the items in real time, automated inventory tracking, and aligning companies in the supply chain.

RFID consists of an active and passive radio frequency (RF) tag applied to the item being tracked and an RF reader/emitter. A passive tag draws energy from the reader, whereas an active tag has its own battery and draws power from there [5]. RFID is a smarter barcode that will one day replace the barcode that we are familiar with today. RFID is an innovative technology that will make the supply chain faster and efficient with less human error. Figure 2.2.1 is a diagram of a typical RFID system; the tag is placed on an item such as, the pallet (hold many boxes), a box (holds many items), or a single item. After the tag is placed on an item, the reader then transponds the information to the RFID software that then processes the information into the communication network or database used by the supply chain partners [12].

### RFID Systems and How It Works

RFID works using radio waves, which means that it is contactless and does not require a line of sight. At its simplest, a RFID transponder is a tag containing a silicon chip (the memory) mounted onto an antenna (the transmitter). This tag is fixed to an item being tagged. This tag is scanned using an RFID reader (also called an interrogator), which sends energy to the transponder using radio waves. These waves power the transponder, which then transmits the information stored in its chip back to the reader for onward processing. The reader transfers this data to various enterprise applications through specialized middleware, which also acts as a reader controller and preliminary data filter and aggregator as delineated in figure 1

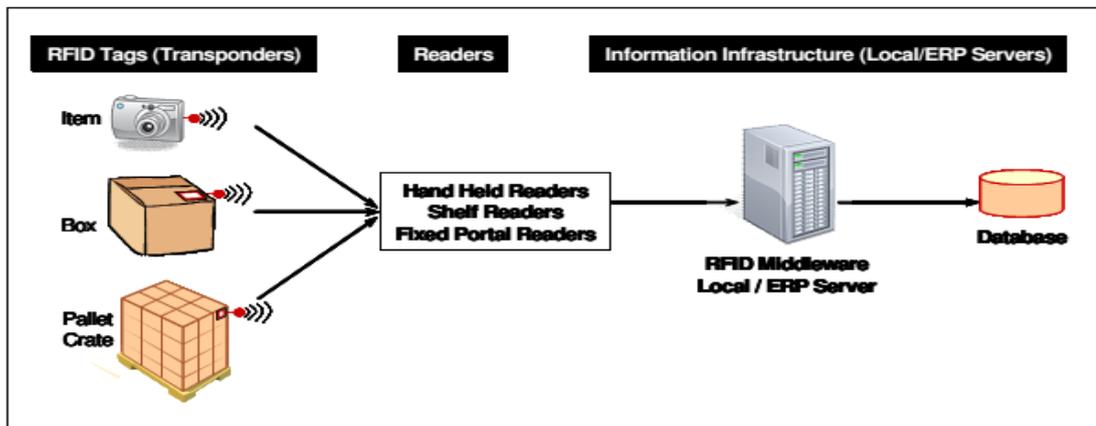


Figure-1 RFID System and How It Works

**Benefits of RFID**

RFID, with its ability to read data in tags attached to items, cases, pallets or containers automatically, without manual intervention and irrespective of placement, orientation and at a high rate, is an ideal technology to enhance the visibility in the supply chain. Additionally, RFID enables each item to be uniquely identified, allowing item level tracking to increase the granularity in the supply chain. The data that can be stored in the tag can range from a simple item code to a complete manufacturing or distribution audit trail. This data can also be updated as the item progresses through the supply chain. RFID technology gives benefits to distributors and retail stores using the technology as depicted in table 2.3.1a and table 2.3.1b that are arising from various aspects.

Today geographic technologies are moving into key business functions enabled by technologies such as RFID tags, embedded Global Positioning System (GPS) capabilities, and spatial analysis features in mainstream database management systems (DBMSs) [2]. The basic benefits that RFID brings to the supply chain are automated real-time data capture related to product information, status information, location and environment status information. Thus, RFID provides a real-time view of how goods are moving through the supply chain, thereby dramatically improving the supply chain visibility, and opening up opportunities for unprecedented gains in the operational efficiency for any organization connected to the supply chain. The basic benefits drive the secondary business benefits, some of which are as listed below:

Table-1 Benefits to Retail Distributors

<i>Business Benefits</i>	<i>Arising from:</i>
<ul style="list-style-type: none"> <li>– Reduce labor costs for warehousing processes</li> <li>– Increase in warehouse processing accuracy and throughput</li> <li>– Increase in inventory accuracy</li> <li>– Speed up physical inventory process</li> <li>– Reduce thefts, misplacement, and misrouting</li> <li>– Optimize work processes to increase productivity</li> <li>– Increase on-time deliveries</li> <li>– Reduce inventory levels and safety stocks</li> <li>– Reduce inventory of obsolete products</li> <li>– Increase assets utilization</li> </ul>	<ul style="list-style-type: none"> <li>– Automated data capture and compare</li> <li>– Tracking goods handled</li> <li>– Enhanced real-time visibility in the supply chain</li> <li>– Tracking location, condition, and contents of assets</li> </ul>

Table-2 Benefits to Retail Stores

<i>Business Benefits</i>	<i>Arising from:</i>
<ul style="list-style-type: none"> <li>- Reduce labor costs, paperwork and quantity reconciliation</li> <li>- Increase in inventory accuracy</li> <li>- Speed up physical inventory process</li> <li>- Increased customer service levels</li> <li>- Reduce thefts, misplacement and misrouting</li> <li>- Better handling of data sensitive inventory</li> <li>- Better returns management and warranty authentication</li> <li>- Better replenishment and or re-order control</li> <li>- Reduce inventory levels and safety stocks</li> <li>- Reduce inventory of obsolete products</li> <li>- Higher sales</li> </ul>	<ul style="list-style-type: none"> <li>- Automated data capture and compare</li> <li>- Tracking goods handled</li> <li>- Enhanced real-time visibility in the supply chain</li> </ul>

**Supply Chain and Supply Chain Management**

Supply chain (SC) is defined as a set of three or more entities directly involved in the upstream flows of products, services, finances, and/or information from a source to a customer [2]. Supply chain is like a pipeline composed of multiple companies that perform procurement of

materials, transformation of materials into intermediate or finished products, distribution of finished products to retailers or customers, and recycling or disposal in a landfill. Supply chain management (SCM) is the efficient management of the flows of material, data, and money in the supply chain, as shown in Figure 2 [11].

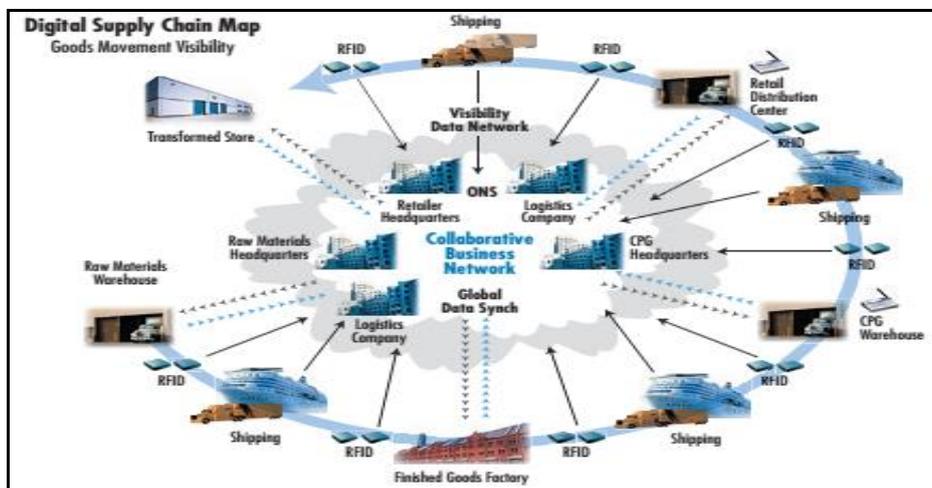


Figure-2 Managing a supply chains with RFID

The use of RFID in the supply chain provides a major opportunity to reduce costs and increase operating efficiencies. Figure 3 illustrates how

RFID can improve the efficiency of a supply chain by improving data quality [11].

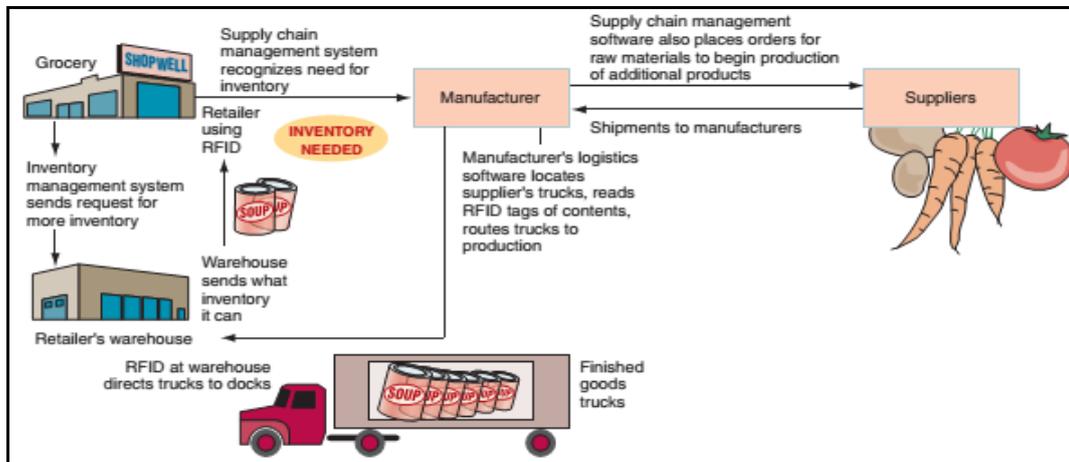


Figure-3 How RFID tags provide the data needed to manage the supply chain

As supply chains become more dynamic and operate in real time, the lines between planning and execution continue to blur. Real time information from execution systems give the capability to feed back into and allow the development of continually adjusting optimal plans. The ultimate realization is perhaps technologies which lead to the adaptive or self-healing supply chain – where a software engine monitors all the numerous events happening supply chain wide, identifies and escalates exceptions, sends notifications and reacts appropriately ([www.riverone.com](http://www.riverone.com); [www.worldchain.com](http://www.worldchain.com); [www.avigile.com](http://www.avigile.com)).

### RFID Affects and Automates the Supply Chain

RFID tags can tell what the product is, where it has been, when it expires, whatever information someone wishes to program it with. RFID technology is going to generate mountains of data about the location of pallets, cases, cartons, totes and individual products in the supply chain. It produces oceans of information about when and where merchandise is manufactured, picked, packed and shipped. RFID creates rivers of numbers telling retailers about the expiration dates of their perishable items—numbers that will have to be stored, transmitted in real-time and shared with warehouse management, inventory management, financial and other enterprise systems. Another benefit of RFIDs is that, unlike barcodes, RFID tags can be read automatically by electronic readers. It has the potential to add a substantial amount of visibility into the extended supply chain.

Since RFID is a valuable technology for tracking inventory in the supply chain, it can synchronize

information and physical flow of goods across the supply chain from manufacturers to retail outlets and to the consumers at the right place at the right time. Likewise, RFID can track returned goods through the supply chain and prevent counterfeit. It also helps to reduce out-of-stock items. There is no doubt that RFID is an invaluable tool for improving inventory management and supply chain efficiencies [12].

### RFID Makes Inventory and Supply Chain Visibility?

Visibility means knowing when the shipment or delivery of goods will be picked up, where the shipment is at every step of its journey, and knowing the full details of the status, condition, and time of its delivery and acceptance. The meaning of visibility in the transportation context is probably the easiest to understand.

Visibility of information and or inventory, in actionable detail, in real time or near real time, on events, orders, inventory, and shipments, up and down multiple levels of a supply chain. In a broader sense, visibility is the increase of available data that can be analyzed to make recommendations and determine strategies to improve and strengthen the supply chain.

### RFID Enhances VMI and Affects CPFR

How does vendor-managed inventory (VMI) work? In the late 1980s, P&G convinced Wal-Mart to implement its continuous replenishment software. One of its first collaborations was with Wal-Mart. Continuous replenishment is a supply chain relationship in which a vendor continuously



monitors the inventory of a retailer or distributor and automatically replenishes their inventory when levels hit the re-order point. In this vendor managed inventory (VMI) situation, P&G manages the inventory of its Wal-Mart eliminating the need for customers to send purchase orders. The advantage to the vendor is having more advanced notice of product demand. The advantage to the retailer or distributor is minimizing inventory costs. Having the correct item in stock when the end-customer needs it benefits all partners.

The concepts of continuous replenishment and collaboration evolved into the more comprehensive model known as collaborative planning, forecasting, and replenishment (CPFR). CPFR is a set of data-driven business processes designed to improve the ability to predict and coordinate with supply chain partners. With CPFR, suppliers and retailers collaborate in planning and demand forecasting in order to ensure that members of the supply chain will have the right amount of raw materials and finished goods when they need them.

#### **RFID Reduces Bullwhip Effect**

Bullwhip effect occurs as orders are placed from retailers, to wholesalers, to manufacturers, with fluctuations increasing at each step in the sequence. The “bullwhip” fluctuations in the supply chain increase the costs associated with inventory, transportation, shipping, and receiving while decreasing customer service and profitability. Bullwhip effect is the increasing in orders that often occurs as orders move through the supply chain [4]. P&G found that although the use of pampers diapers was steady and the retail-store orders had little fluctuation, as orders moved through the supply chain, fluctuation increased. By the time orders were initiated for raw materials, the variability was substantial. Wal-Mart succeeded in adopting RFID to boost its supply chain has caused reducing the bullwhip effect and improving opportunities in the supply chain.

#### **RESEARCH METHODOLOGY**

Exploratory research was conducted to explore the RFID technology and the supply chain through related case studies, literatures and books related to RFID technology and supply chain management. The literatures and books that have been used in this paper were based on a wide range of online industry sources, including RFID vendor web sites, standards organizations, whitepapers and press releases. The online sources were complemented

by hardcopy documentation including academic papers such articles and research journals. The relevant material was gathered, categorized and sorted into like themes which formed the basis for analyzing how RFID boosts and enhances supply chain management. Second, descriptive research was conducted to describe characteristics of RFID technology and supply chain management that have been implemented in Walmart giant store. Lastly, the aim of this research is to delve deeply into how the RFID boosts and enhances Walmart’s supply chain management, and analyze the objective.

The primary method of data collection in this case study are based on secondary data sources such as articles, journals, etc. related to the research purpose. Most of the data required through internet and Web browsing ([www.walmart.com](http://www.walmart.com)). Wal-Mart Stores, Inc. is based in Bentonville, Arkansas founded by Sam Walton in 1962. Wal-Mart was the world’s largest retailer with more than 6,500 stores worldwide, including stores in all 50 states. Its sales volume reached \$ 312.4 billion in 2006. Some of the major suppliers of Wal-Mart are Gillette, Hewlett-Packard, Johnson & Johnson, Kimberly-Clark, Kraft Foods, Nestle, Purina PetCare Company, Procter & Gamble and Unilever. “With Wal-Mart selling over \$245 billion worth of goods in fiscal year 2003, a 1% improvement in the out-of-stock issue could generate nearly \$2.5 billion in very profitable sales.”

#### **RESULTS AND ANALYSIS**

##### **RFID Technology Boosts Walmart’s SCM**

Walmart has grown to be the world’s largest retailer by seeking every opportunity to streamline its supply chain and cut costs in order to live up to its promise of “*everyday low pricing.*” Getting there entails more than merchandising, however. Walmart also is a leader in pioneering technologies to achieve operational efficiencies that ultimately bring savings for its customers.

Wal-Mart had initiated its plan to employ RFID technology in its supply chain in June 2003. Subsequently Wal-Mart reinforced its plans and actively asserted on defining the RFID standards it will be implementing. The specification of the following RFID components was laid out in November 2003 with EPC specification, type of Chip that would be installed, and the Distribution centers that will accept RFID tagged products. The company initially introduced RFID to track pallets of merchandise travelling along its supply chain,

including at warehouses. In 2007, executive credited the technology with, among other things, cutting the volume of excess inventory in Walmart's massive supply chain and slashing out-of-stock occurrences by almost one-third.

RFID has transformed the way Wal-Mart runs its retail store. The movement of goods along the supply chain is reflected by corresponding movements of information sent by RFID reader. This information is captured via a bar code reader and can then be read immediately anywhere in the distribution chain. Computers communicate with other computers via local area, national and, in some cases, international networks. However, without properly designed supply chains supported by RFID technology, and capable people, this will not succeed.

Wal-Mart's collaboration with P&G meant that P&G would assume more responsibility for inventory management, something retailers have traditionally done on their own. When P&G's products run low at the distribution centers, the system sends an automatic alert to P&G to ship more products. In some cases, the system goes all the way to the individual Wal-Mart store. It lets

P&G monitor the shelves through real-time satellite link-ups that send messages to the factory whenever a P&G item swoops past a scanner at the register. With this kind of minute-to-minute information, P&G knows when to make, ship and display more products at the Wal-Mart stores. It does not need to keep products piled up in warehouses awaiting Wal-Mart's call. Invoicing and payments happen automatically too. The system saves P&G so much in time, reduced inventory and lower order processing costs that it can afford to give Wal-Mart "low, everyday prices" without putting itself out of business.

Wal-Mart uses radio frequency tags for keeping its shelves stocked. Its supply chains work smoothly when sales are ready, but often break down when confronted by a sudden surge in demand, especially when Wal-Mart campaigns a special promotion that causes its shoppers snap up all the promotional items. The RFID tags can change that by providing real-time information about what is happening on store shelves. Here's an example how the system works for Procter & Gamble's (P&G's) pampers as shown in figure 4:

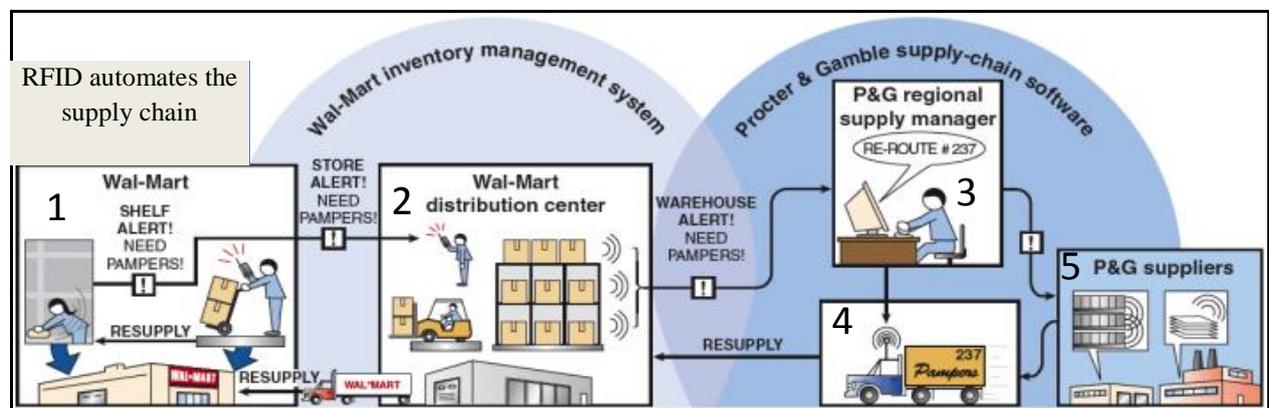


Figure-4 The Way Wal-Mart uses RFID Technology in Managing Its Inventory

In Figure 4 Box 1: When P&G's products run low at the distribution centers, the system sends an automatic alert to P&G to ship more products. In some cases, the system goes all the way to the individual Wal-Mart store. It lets P&G monitor the shelves through real-time satellite link-ups that send messages to the factory whenever a P&G item swoops past a scanner at the register. For instant, each box of Pampers has an RFID tags. Shelf-mounted scanners alert the stockroom of urgent need for restock.

In Figure 4 Box 2: This shows how vendor-managed inventory (VMI) works. Continuous replenishment is a supply chain relationship in which a vendor continuously monitors the inventory of Wal-Mart or P&G and automatically replenishes their inventory when levels hit the re-order point. In this vendor managed inventory (VMI) situation, P&G manages the inventory of its customers eliminating the need for customers to send purchase orders. The advantage P&G is having more advanced notice of product demand. The advantage to Wal-Mart or distributor is



minimizing inventory costs. Having the correct item in stock when the end-customer needs it benefits all partners. Wal-Mart's inventory management system tracks and links its in-store stock and its warehouse stock, prompting quicker replenishment and providing accurate real-time data. Here, three main problems of supply chain management that can be improved through RFID; inventory inaccuracy, the bullwhip effect and replenishment policies.

In Figure 4 Box 3: RFID has transformed the way Wal-Mart runs its retail store. The movement of goods along the supply chain is reflected by corresponding movements of information sent by RFID reader. This information is captured via a bar code reader and can then be read immediately anywhere in the distribution chain. Wal-Mart systems are linked to the P&G supply chain management system. Demand spikes reported by RFID tags are immediately visible throughout the supply chain.

In Figure 4 Box 4: After the deployment of RFID technologies, Procter & Gamble and Wal-Mart simultaneously reduced inventory levels by 70%, improved service levels from 96% to 99%. They also reduced administration costs by re-engineering their supply chains. P&G's logistics software tracks its trucks with GPS locators, and tracks their contents with RFID tag readers. Regional managers can reroute trucks to fill urgent needs.

In Figure 4 Box 5: P&G logistics executives examined the order patterns for one of their best-selling products, Pampers diapers. Figure 2.4.2 shows how the swings, which look like bullwhips, intensify from retailers to distributors to manufacturers. P&G's suppliers also use RFID tags and readers on their raw materials, giving P&G visibility several tiers down the supply chain, and giving the suppliers the ability to accurately forecast demand and production.

#### **Wal-Mart's Competitive Advantage is Its Supply Chain**

Competition is no longer between Wal-Mart and P&G, but it now between supply chains, and Wal-Mart knows the ways. No other company has a more efficient supply chain, and no other company has embraced outsourcing to China more vigorously than Wal-Mart. Perhaps as much as 85% of Wal-Mart's merchandise is made abroad.

The benefits of RFID in the Retail Supply Chain are Wal-Mart suppliers moving forward with electronic product code (EPC) RFID implementations to gain operational improvements, such as 100 percent inventory visibility; major reduction in losses and shrinkage; tracking lot and expiration dates; work in process data management; enabling tags to carry real-time databases of item information; assigning unique serial numbers to items; and sharing EPC and other product data with partners in the supply chain.

Through this innovative attempt, Wal-Mart provided a considerable acceleration to RFID implementations in supply chains.

Roberti [7] shows that out-of-stock items with RFID were replenished three times faster than items using standard barcode technology. According to the analysis of the University of Arkansas, Wal-Mart succeeded in adopting the RFID technology and reduced out-of-stocks by 16% [3]. He also concludes that Wal-Mart experienced a 10% reduction in manual orders resulting in a reduction of excess inventory.

The global RFID market was expected to top \$ 7.6 billion in 2012, up more than \$ 1 billion over the previous year. That total included spending on RFID tags, readers, software and services. In retail, RFID is seeing rapid growth for apparel tagging-this application alone demands 1 billion RFID labels in 2012, with 1.35 billion tags forecast for 2013.

#### **CONCLUSION AND PERSPECTIVE**

This survey covered potential benefits of RFID technologies in supply chains; cost reduction and value creation, particularly related to inventory inaccuracy and the bullwhip effect. RFID technologies can provide several advantages in supply chain management through better traceability and improved visibility of products and processes all along the chains. Increase of efficiency and speed of processes, improvement on information accuracy, reduction of inventory losses are some of these advantages. There have been important implementations conducted by pioneer companies such as Wal-Mart and Procter & Gamble. However, real applications of RFID technologies are still limited because the costs of RFID are still often much larger than the costs of current identification technologies.



RFID technologies are perfect and can eliminate all errors in the supply chains. This case study shows that choosing the right technology and environment is a critical decision for companies to gain the most out of RFID technologies. Furthermore, it indicates that employing RFID technology will help in implementing a seamless supply chain and hence yield profits.

Wal-Mart is able to offer consumers an *every-day-low-price* largely in part because it is able to control its costs. The cost of its products, however, is not only a function of its efficiency or lack of it but also the efficiency/inefficiency of its suppliers. Because of the volume of products sold by Wal-Mart, it has a great influence over its suppliers and often pressures its suppliers to find ways to lower costs. Though it has a large influence over these suppliers, it is impossible for Wal-Mart to operate without their assistance, and thus it is important for Wal-Mart to maintain mutually beneficial relationships with its suppliers. Sharing benefits and costs in, instead of mandating the use of, technology implementations is an effective way for Wal-Mart to cultivate a mutually beneficial relationship with its suppliers. The novelty and frailty of certain technologies like RFID, however, sometimes preclude a timely and effective implementation of them. A technology's benefits are felt the more its use is standardized throughout the marketplace. Once unit cost has decreased and privacy issues have been resolved, many more companies will be able to implement RFID as an effective means to improve supply chain management efficiency.

By adopting RFID, Wal-Mart and its suppliers can drive business value. They have moved towards extensive incorporation of RFID technology, they have faced a number of issues. First, inventory must be managed not just by the retailer but also by its suppliers. That means retailers may mandate specific RFID technology and implementation methods, which can prove costly to some suppliers. For organization of all types, the ability to quickly pinpoint and quantify merchandise and other assets can be an invaluable component of supply chain management – and may also drive business value.

Furthermore, the components of this technology are becoming smaller and smaller, less expensive and more effective. Thus, applications of RFID in supply chain have increased. Bagchi et al. [1] reported the prediction of RFID growth as from \$1

billion in 2003 to \$4 billion in 2008 to \$20 billion in 2013.

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