Chapter 8
Improving the Retailer Industry Performance Through RFID Technology: A Case Study of Wal-Mart and Metro Group

Omar Ali
University of Southern Queensland, Australia

Ray Hingst
University of Southern Queensland, Australia

EXECUTIVE SUMMARY

This study focuses on RFID and its implementation at two retail chains, Wal-Mart in United States (U.S.) and Metro Group in Europe, who have successfully implemented this technology. It identifies the impact of RFID on improving supply chain performance in the retail industry. The researchers have concentrated on both explorative and indicative studies in an effort to understand the impact that the adoption of RFID technology will have on improving the performance of the supply chain by comparing two different case studies. This research study has found that coordination and integration operations are important for inventory management and related operations, and they are also important factors that contribute to performance improvement in both case studies. In addition, this research study has found that RFID's information-sharing support for buyers in the supply chain has promoted the accuracy of purchasing forecasts. Finally, it is found that RFID has provided increased flexibility of operations, using smart shelves and reducing the cost of inventory management.

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INTRODUCTION

Radio Frequency Identification (RFID) technology is hailed by most industry experts and technology pundits as 'one of the most exciting technologies for SCM' (Wu & Subramaniam, 2009), but it is the sub-field of retail that has seen, and continues to show, the most potential for growth for the application of this technology. RFID provides accurate, up-to-date, practical information about product identification data, pricing, and dates of manufacture and expiration, and with the use of geo-navigational instruments, it allows producers to pinpoint and track their products and quickly calculate the current inventories on hand (Ilie-Zudor et al., 2011). As noted previously, introducing RFID technology into a business enhances and increases speed, accuracy, detailing, and visibility of operational information of specific units of production (Moberg & Speh, 2003). Implementing this technology in business leads to shorter production cycles, reduced overall labour costs, improved delivery and more reliable customer service (Bose & Pal, 2005).

This chapter will explore the benefits of RFID technology through its application to the supply chains in two leading global retailers: Wal-Mart and Metro Group.

TECHNOLOGY BACKGROUND

Automatic Identification (Auto-ID) is a broad term given to technologies that are used to help equipment to identify objects. Auto-ID is often coupled with automatic data capture. That is: identify different items, capture information about them and transfer the data into an Information System (IS). Auto-ID technologies include different technologies such as Bar-Codes, smart cards, RFID, optical character recognition (OCR) and Biometrics such as (fingerprint procedure and voice recognition). This research focused on RFID technology.

Radio Frequency Identification Technology (RFID)

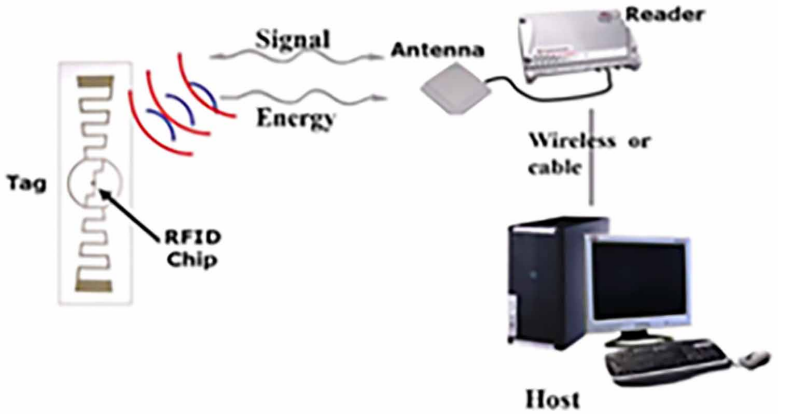
RFID relies on the assignment of a radio frequency to every item tracked within a SC which acts as the item's identity (Wu & Subramaniam, 2009). The most important advantages over the use of barcodes are the possibility of identify items without line of sight (Curtin et al., 2007; Karmakar, 2010), simultaneous reading of several tags, which is achieved by anti-collision mechanisms and the ability to identify items uniquely using the Electronic Product Code (EPC) concept. Because RFID systems can be run without the need for human interaction, the scanning process can be fully automated (Karmakar, 2010).

RFID technology is a technology that uses radio frequency waves to transfer data between a reader and a movable item for the purpose of identifying, categorizing, tracking and monitoring products (Columbus, 2005; Wu et al., 2006; Wu & Subramaniam, 2009). A typical RFID system is comprised of tags, readers, and software (Wamba et al., 2007). Tags are the key component and are placed on the entity which is identified as data carrier; readers can read/write data on tags and transmit the data between readers and tags; and software integrates an RFID system which usually includes a front end which manages the readers and tags and a middleware which routes this information to servers in order to run the back-end database applications (Asif & Mandviwalla, 2005; Ngai & Gunasekaran, 2009). An RFID system is composed of a transponder and a reader linked to a computer system as shown in Figure 1 (Ton et al., 2009; Chang, 2011; Zelbst et al., 2011).

There are two types of tags: active tags, which have batteries, and whose read/write ranges are longer, and passive tags, which have no batteries and shorter ranges (Hassan & Chatterjee, 2006; Buzzi et al., 2011). Passive tags are much cheaper than active ones and have much broader applications (Kasiri et al., 2012); however, active tags can provide more power to collect and transmit data (Kasiri et al., 2012).

Furthermore, data read from RFID tags are highly accurate (Kapoor et al., 2009). Tags do not need to be "in the line of sight" of the readers and can be read from several meters away (Zelbst & Sower, 2012). According to research by Bilge and Ozkarahan (2004), stated that tags can use a memory storage device to store a certain amount of data, such as product identification number, cost, and manufacture date, location and inventory on hand. This type of information can be quickly read by a wireless scanner, so RFID can process large volumes of multiple data sets at the same time and improve efficiency of operations by using identification tags

Figure 1. RFID System (Karmakar, 2010)



to monitor processes for time, place, and person accurately. Tags and readers may operate in various frequency ranges, which are usually applied in different fields: Low Frequency (LF) with 125/134 kHz and 140/148.5 kHz, High Frequency (HF) with 13.56 MHz, Ultra-High Frequency (UHF) with 915 MHz (US) and 868 MHz (EU) and Microwave Frequency (MF) with 2.4 GHz or higher (Buzzi et al., 2011). Tags can provide rewritable memory, and it can interface with environmental sensors (Zelbst & Sower, 2012).

There are three main benefits from RFID applications in retail SC. First, identifying and tracking product information from RFID systems can enable firms to integrate inventory timeliness; for example, a study reported that RFID can make a savings of 16 percent in out-of-stock (Hardgrave et al., 2005). Based on the product tracking information from RFID systems, inventory management system and warehouse management system can be integrated; delivery process improvement will also be realized (Daw, 2003). Secondly, RFID technology can greatly reduce or avoid shrinkage, which is the financial losses attributable to a combination of employee theft, shoplifting, administrative error, and vendor fraud (Daw, 2003; Wilding & Delgado, 2004). According to National Retail Security Survey, the total shrink percentage of the retail industry in the United States (U.S.) was 1.7 percent of sales in 2001. Considering the retail base of $1.845 trillion in 2001, the 1.7 percent means approximately $31.3 billion annual loss from shrinkages for retailers (National Retail Security Survey, 2002). Thirdly, RFID technology can help companies improve SC planning in three ways: enhanced information visibility, increased information accuracy, and privacy and security issues (Twist, 2005).

RFID systems in retail SC context are a part of an inter-organizational system (IOS), which aims to generate more efficient and effective business processes and decision making (Ngai et al., 2008; Wamba & Ngai, 2015). RFID system spans the SC partners' boundaries to gather and share the real time information captured by RFID tags within and between firms. Therefore, RFID systems share the common characteristics of IOSs, such as cross organizational boundaries, automated sharing information, across multiple business processes. RFID systems create a dynamic SC that improves operations including manufacturing, distribution, transportation and retailing (Rutner et al., 2004). RFID systems enable real-time decision making for higher effectiveness and efficiency of business operations (Pero & Rossi, 2014; Crumbly & Cater, 2015; Wamba & Ngai, 2015). For instance, by using RFID technology, vehicles and cargoes can be identified as they enter a warehouse compound and then be automatically directed to the right location to be unloaded or loaded.

SETTING THE STAGE

Information Technology has been the fundamental infrastructure of competition and cooperation for today's enterprises, and the positive effects of IT on SC performance (Kushwaha, 2012). According to a research conducted by Mohammadi et al. (2012), IT is evident in all SC fields ranging from the relationship with suppliers and producers to the relationship with the customers. According to research conducted by Zelbst et al. (2010), RFID facilitates information-sharing infrastructure's ability to capture real-time information across the whole SC, which allows for the SC to improve performance. Further, Smith (2005) reported that the RFID system could support Customer Relationship Management (CRM) and increase customer satisfaction. A CRM system with an RFID-based system would be able to track consumers' buying behaviours and deliver products in a timely fashion.

Based on research by the Grocery Manufacturers of America (GMA) cited in Ton et al., (2009) 25-30 percent of all grocery stock outs involved products that were at the store but not on the display shelves. Also, Goebel and Günther (2011) found that roughly 25 percent of the store related stock-outs resulted from ineffective store shelving. On the other hand, a study by Zhou (2009) examined the relationship between inventory inaccuracy and performance in a retail SC, showing that increasing inventory accuracy can reduce SC cost as well as out-of-stock level. Furthermore, Gaukler (2011) has demonstrated that item-level RFID technology can help improve the accuracy of both store orders, as well as the backroom-to-shelf process, which are two of the main causes of out-of-stock events.

Evidence of RFID's Impact

According to Kasiri et al. (2012), by 2008 Gillette and Wal-Mart measured how the volume of their sales had improved through better promotion execution. They monitored the promotional items in distribution centres, the back-store and promotional displays to provide the items on time and avoid out-of-stock, achieving 19 percent increase in sales. Similar examples from SC in a wider organizational context have shown distinct benefits from the application of RFID technology:

- In the apparel industry, RFID-enabled mirrors have been used to improve the shopping experience and to increase sales. An upscale Hong Kong fashion label and retailer had a sales increase of 30 percent at two stores using an RFID-enabled mirror in the dressing room. The system reads the garment and visually recommends mixed and matches items, providing the customer with more choices and the retailer with more sales opportunities (Swedberg, 2007a).

- One of the most important special effects of automation is in the area of inventory control, where the use of RFID can lead to a complete elimination of manual shelf inspections by triggering automatic shelf replenishment based on recorded product movement, which then reduces stock-outs. (Visich et al., 2009).
- The U.S. Marines implemented RFID for their SC to Iraq. The impact was a reduction in average delivery times from 28 to 16 days, reduction in supply backlog from 92,000 shipments to 11,000 shipments and reduction in total inventory value in the SC from $127 million to $70 million (Collins, 2006b).
- A six-month research study by Hardgrave et al. (2008) of 4554 items in 24 Wal-Mart stores found that stock-outs were reduced by 26 percent at 12 RFID-enabled stores. Stratification of the items by sales rate showed reductions of 20-36 percent for those items with a sales rate of 0.1 to 7 units a day and 62 percent for items with a sales rate of 7 to 15 units per day. There was no impact on items with a sales rate of greater than 15 units a day, but 90 percent of the items in the study had a sales rate of three or less per day.

Evidence of RFID in Retail Sector

According to Rekik and Dallery (2008) reducing inventory and out-of-stock were the two important objectives of Wal-Mart's RFID initiative. Wal-Mart holds approximately $20 billion in inventories and has an annual inventory turnover rate of six; increasing inventory turns from six to twelve could free up $12 to $14 billion in cash per annum (Corsten & Gruen, 2006). Table 1 provides evidence of process improvements delivered by the application of RFID technology.

Evidence of RFID in Logistics Providers

Benefits of RFID for logistics providers have been identified for a variety of warehouse and transportation processes and activities. Table 2 demonstrates the evidence of RFID in logistics processes including receiving, shipping and inventory control, as well as various yard management activities.

Evidence of RFID in the Whole Supply Chain

It has been noted by a large number of authors that the highest level of benefit from RFID will occur when RFID is implemented across multiple SC partners. In this part the research presents evidence of RFID benefits for open-loop and closed-loop SCs. Open loop SC is a system whose constituent parts include material suppliers, production facilities, distribution services and customers linked together by the feed

Table 1. Evidence of RFID in the retail sector

Processes	Evidence
Receiving	Pallet breakdown: decreased from 17.5 to 2.5 minutes (O'Connor, 2006)
Backroom Inventory Management	Understated perpetual inventory (PI): reduced by 13% (Hardgrave et al., 2009)
	Time for inventory count: 80% reduction (Roberti, 2007)
	Inventory count accuracy: 98-99% (O'Connor, 2007a)
	Inventory replenishment: 3 times faster (Wang et al., 2008)
	Manual inventory order: 10-42% reduction (Chain Store Age, 2005; O'Connor, 2007a)
	Products locating accuracy: 99% (Visich et al., 2009)
Store Floor	Stock-outs: reduced 21% (Hardgrave et al., 2008).
	Shelf-availability: increased to 100% (Visich et al., 2009)
Promotions and Sales	Promotion product availability: 92% (Collins, 2006c)
	Promotion sales: 48-140% increase in stores moved the display to their location before promotion (Roberti, 2005; Chain Store Age, 2007)
	Units sold: 14-41% increase (Chain Store Age, 2007)
	Sales: 14-30% increase (Chain Store Age, 2007)

forward flow of materials and feedback flow of information (Stevens, 1989). It is characterised by a SC in which there is no flow back from the customer is referred to as an 'open loop SC' (Debo et al., 2005). Table 3 illustrates the evidence in open-loop SCs.

Closed loop SC are SC networks that "include the returns processes and the manufacturer has the intent of capturing additional value and further integrating all SC activities" (Guide Jr & van Wassenhove, 2003). Table 44illustrates the evidence of RFID in closed-loop SCs.

CASE DESCRIPTION (RFID IN RETAIL SUPPLY CHAINS)

RFID is considered in IT terms as advancement for retail business (Banks et al., 2007). It is a technology that was high on the priority list of some international retailers such as Wal-Mart in the U.S. and the Metro Group in Germany about ten years ago.

RFID-enabled solutions were introduced in the Wal-Mart system at the beginning of 2005. The German retailer Metro Group has taken an even more aggressive approach. Since August 2006, the group has deployed second generation RFID tags to the Point of Sale (POS) cases such as the Future Store in Rheinberg and at Real, an important step to further improve goods availability for consumers (Metro Group, 2008).

Table 2. Evidence of RFID in logistics providers

Processes	Evidence
Receiving	Arrival inspection time: reduced from 10-50% (Holmqvist & Stefansson, 2006)
	Check in and trucks unload: reduced by 15 to 20 minutes (Burnell, 2005)
	Order verification: reduced from 20 seconds to 5 seconds (Katz, 2006)
	Productivity for receiving goods: 57% (Bacheldor, 2006)
	Time needed to compare deliveries with orders: 80% reduction (Wessel, 2007)
	Time to process a delivered pallet: reduced 51% (O'Connor, 2006)
Shipping	Time to process an order for shipment: reduced from 45 minutes to 6 minutes, or reduced to 20 seconds compared with 80 seconds to 20 minutes for a barcode system, or reduced by 80% (Wessel, 2008)
	Pallet build speed: reduced from 90 to 11 seconds (Shister, 2005)
	Time to load a truck: reduced from 50 to 20 minutes, 40% faster (Swedberg, 2007a)
	The accuracy of pallets shipping to customers: increased from 92-97% (Chow et al., 2006)
	Invoice discrepancies: reduced from 80-0% (Collins, 2005b)
Inventory Management	Warehouse labour: 14% reduction (Burnell, 2005)
	Stock availability: 10-11% increase (Visich et al., 2009)
	Lost goods: 18-20% reduction (Burnell, 2005)
	Inventory count accuracy: increased from 95-99% (O'Connor, 2007a)
	Stock turnaround: increased from 5.5 to 6 (O'Connor, 2007b)
Yard Management	Time for double transaction (drop-off and pick-up): 66% reduction (Blanchard, 2004)
	Parking spaces: save 40-60 at a given time (Blanchard, 2004)
	Gate personnel productivity: improved 50% (Blanchard, 2004)
	Daily throughput: 38% during peak season (Blanchard, 2004)
	Reduced labour: 2 persons by up to 60 hours (O'Connor, 2008)
	Reduced tractors: 120 to 67 per year (Visich et al., 2009)
	Container locating: from 4 to 12 hours to immediately (Schor, 2006)
	Gate efficiency: improved 75% (O'Connor, 2007c)

Case Study 1: The Wal-Mart Group U.S. Retailer

An in-depth look at Wal-Mart's history is important in order to understand its rapid growth and relationship with its employees and customers, and how its history has shaped the company's standing and reputation. The first Wal-Mart was opened in 1962 by founder Sam Walton in Rogers, Arkansas with the help of Bud Walton. After five years, the company had increased to 24 stores within Arkansas and sales had reached US$12.6 million. In 1974 Wal-Mart continued its expansion into eight states.

Table 3. Evidence of RFID in open-loop supply chains

Processes	Evidence
Supply Chain Response Time	Supply chain response time: reduced from 7 to 5 days (Swedberg, 2007b)
	Inbound and outbound through-put time: reduced by 50% (Deffree, 2005)
	Handing time: reduced by 50% (Deffree, 2005)
	Delivery time: reduced from 28 to 16 days (Collins, 2006a)
Supply Chain Cost	Labour cost: reduced by 25% (O'Connor, 2007d)
	Inventory cost: reduced from $127 million to $70 million (Collins, 2006a)
	Product loss: 10% reduction (Swedberg, 2007c)
Supply Chain Efficiency	Number of goods processed: doubled or tripled (O'Connor, 2007e)
	Rush order processing: reduced from 6 hours to 2/3 hours (O'Connor, 2007e)
Integrated Supply Chain Benefits	Supply chain cost: reduced by 75%. Revenue: increased by 10%. Capacity: increased up to 15%. Process lead time: reduced by 70%. Customer complaints: reduced 22% (Ustundag & Tanyas, 2009)
	Average delivery time: reduced from 28 to 16 days. Supply backlog: reduced from 92,000 shipments to 11,000 (Collin, 2006a)

Table 4. Evidence of RFID in closed-loop supply chains

Processes	Evidence
Reusable Assets	Read time for reusable assets: reduced by 83% (Wilding & Delgado, 2004b)
	Shrinkage: reduced by 15% (Wilding & Delgado, 2004b)
	Container loss: reduced from 4-2% (Wilding & Delgado, 2004a)
	Container cycle time: reduced from 47 to 40 days (Visich et al., 2009)
	Container purchasing cost: reduced by 4 million pounds per year (Wilding & Delgado, 2004a)

By 2016, with sales of U.S. $478,416 billion, Wal-Mart was then the most important international retailing company and also the largest retailer around the world. The company operates at around 11,528 stores and clubs located in different countries which includes stores in all 50 states in U.S. as well as international stores (for example Argentina, Brazil, Canada, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Puerto Rico, the UK), and employs around 2.3 million employees, serving more than 176 million customers a year. (Wal-Mart Stores, 2016).

RFID in Wal-Mart

In April 2004, Wal-Mart began its RFID pilot project by receiving cases/pallets of product with EPC tags at a single distribution centre in Texas as part of a test being conducted with 8 suppliers. The tagged goods were to track goods to the back of

8 Wal-Mart stores in Texas served by the distribution centre. The first 8 suppliers, which tagged just a small number of SKUs, were Gillette, Hewlett-Packard, Johnson and Johnson, Kimberly-Clark, Kraft Foods, Nestlé Purina Pet-Care, Procter and Gamble and Unilever. In the same year Wal-Mart met with its top 100 suppliers and the next 200 suppliers in Bentonville to lay out its RFID tagging requirements and timeline. Suppliers were told that by June 2005, RFID systems would be operating in up to six of its distribution centres and 250 stores. Wal-Mart further said that it expected using EPC technology in up to 13 distribution centres and 600 Wal-Mart and Sam's Club stores by the end of 2005 (Supply Chain Digest, 2009).

In January 2005, most of the top 100 suppliers had started shipping some tagged products to 3 Wal-Mart distribution centres in Texas. In March of the same year, Linda Dillman, the CIO of Wal-Mart, said that the Wal-Mart was on track to support RFID capability in 600 stores and 12 distribution centres by the end of the year. Also by the end of 2005 Wal-Mart had installed RFID systems in more than 500 stores and five distribution centres. On the same date, Wal-Mart sponsored a report by the University of Arkansas' IT Research Institute. The report was based on a preliminary study of the impact of RFID on reducing retail out-of-stock. The researchers concluded that RFID had reduced out-of-stock at store level by 16 percent over non-RFID based stores (Supply Chain Digest, 2009).

RFID tags have allowed Wal-Mart to increase stock visibility as stock moves in trucks, through the distribution centres and on to the stores. Wal-Mart is able to track promotions effectiveness within the stores while cutting out-of-stock sales losses and overstock expenses. The company places RFID tag readers in several parts of the store:

- At the dock where merchandise comes in
- Throughout the backroom
- At the door from the stockroom to the sales floor
- In the box-crushing area where empty cases eventually wind up.

With these readers in place, store managers know what stock is in the backroom and what is on the sales floor (Richard Ivey School of Business, 2008).

Benefits of RFID at Wal-Mart

According to Collins (2005a) reducing out-of-stock is a problem that impacts on retailers and their suppliers around the world with regard to around 8 percent of stock items. According to Kasiri et al., (2012), by 2008 Gillette and Wal-Mart had measured how much sales would improve through better promotion execution. They monitored the promotional items in distribution centres, the back-store, and

promotional displays to provide the items on time and avoid out-of-stock and achieved a 19 percent increase in their sales.

According to Bhuptani and Moradpour (2005) improvements resulting from the Wal-Mart RFID implementation were as follows:

- Wal-Mart eliminated many manual processes including those in receiving, inventory management, shipping and payables
- Wal-Mart was able to reduce inventory shrinkage and out-of-stock situations by automatically tracking product movement
- Reduced number of data entry errors
- Shoppers got a better deal as the system became more efficient
- The right products were available at the right stores at the right time
- Predicting product demand became easy
- Shoppers saved time.

Case Study 2: The Metro Group German Retailer

The Metro Group dated back to 1964 when Otto Beisheim, a young sales entrepreneur, founded Metro Cash & Carry, a wholesale business serving commercial customers in the small German town of Muelheim. Three years later, Beisheim received backing from two wealthy families of entrepreneurs, Haniel and Schmidt-Ruthenbeck, allowing the company to expand rapidly in Germany. During the 1970s, the company expanded its wholesaling operations within Europe and also moved into retailing. In the early 1990s, it acquired a majority stake in a department store chain, Kaufhof, and in a supermarket company, Asko Deutsche Kaufhaus. In the late 1990s, the company increasingly promoted its international expansion (Metro Group, 2016).

By 2016, with sales of €58.417 billion, Metro has become one of the most important international retailing companies. The company operates at more than 2,064 outlets and employs about 219,678 employees. Metro was organized around five independent sales divisions: Metro Cash & Carry (Wholesale), Real (Hypermarkets), Extra (Supermarkets), Media Market and Saturn (Consumer Electronics) and Galeria Kaufhof (Department Stores) (Metro Group, 2015/2016).

RFID in Metro Group

In early 2002, the Metro Group, Germany's biggest retailer, announced its upcoming RFID technology rollout at 250 stores and 10 warehouses, in collaboration with 100 suppliers. The news echoed throughout the retailing community.

In April 2003, Metro began testing RFID technology in its Future Store under the leadership of Dr. Gerd Wolfram, managing director of Metro's internal IT

service group, Metro Group IT GmbH (MGI). In July 2004, the company further demonstrated its commitment to RFID by opening the Metro Group RFID Innovation Centre, a platform to develop and promote the technology. By August 2005, the RFID rollout had expanded to 33 suppliers, 9 Metro DCs, and 13 Metro stores. Each level of granularity, however, brought additional complexities and increased implementation costs.

In 2006, selected suppliers were tagging cartons with transponders. In line with this development, Metro Group switched its RFID processes to the new EPC global Class 1/Gen. 2 standard. This step brought a considerable increase in performance and also provided a single standard with which suppliers and retailers could work (Collins, 2006a). By the end of 2007, Metro Group had already introduced RFID at around 400 locations throughout Europe, including all of its German Metro Cash and Carry wholesale stores, nine distribution centres belonging to the group logistics provider MGL and the majority of its Real hypermarkets (Metro Group, 2008).

Around 180 consumer goods companies are already involved in the introduction of RFID in Germany. They tag all pallets bound for Metro Group's stores and warehouses with transponders (Metro Group, 2008). These Smart Chips store the EPC, which provides every pallet with a unique identity. At the outgoing goods portal, an RFID reader registers the EPC and in a split second, compares the delivery with the actual order. If everything is correct, the goods are approved for dispatch and the producer sends an electronic confirmation to Metro Group. Trucks then transport the delivery to one of the central distribution centres. Here, the pallets are registered by the RFID readers at the incoming goods portal. Warehouse staff then re-sorts the pallets for the various Metro Group stores and reload them onto delivery trucks. At the outgoing goods portal there is another automatic check via RFID. The information and the delivery date are electronically transmitted to the stores. When the trucks are unloaded at the store, RFID readers automatically compare the delivered goods with the order. The incoming goods are then entered into the database. This means that store managers always know exactly which products they need to reorder and when (Metro Group, 2008).

Benefits of RFID at Metro Group

According to the Metro Group (2008), adoption of RFID will lead to:

- Positive effects on logistics efficiencies that can result from RFID adoption may also contribute to the achievement of environmental sustainability objectives, essentially by reducing pollution caused by commercial vehicles due to optimised asset management and dynamic transportation routing abilities

- Attainment of lean SC capabilities in distributive trades leveraging on the combined usage of RFID and smart sensors
- Provide a better consumer experience and front-end retail innovation
- Reducing shrink in the SC. The retail industry estimated shrink levels to be approximately 2 percent of sales worldwide. According to some estimates, inventory theft either by store employees or by customers cost U.S. retailers close to 1.3 percent of annual sales, or more than $26 billion. In Metro case 11-18 percent of reduction was experienced, depending on product category
- Improving on-shelf availability and reducing out-of-stocks. At fashion retailers, the percentage was high. A Kurt Salmon Associates survey of customers shopping at apparel retailers, for example, found that one-third of customers entering a store left without making a purchase because they could not find what they were looking for. Out-of-stocks had a significant impact on sales, brand loyalty, and consumer satisfaction
- Improving availability of stock on shelf in U.S. supermarkets. Stores often received products in case packs and not all the units in the case packs sent to the stores could fit on the display shelves. Units that did not fit on the display shelves were often kept in backrooms. They were supposed to be brought to the display area when the units in the display area were sold, but often this did not happen. Sometimes, the employees did not even have time to shelve the new merchandise that arrived at their store. Hence, products often ended up in backrooms and were not available to the customers. According to research by the Grocery Manufacturers of America (GMA), 25-30 percent of all grocery stock-outs involved products that were at the store but not on the display shelves (Ton et al., 2009). RFID technology improves the replenishment process from the backrooms and hence reduces out-of-stocks at the stores. In the Metro Group's case 10-20 percent reduction of out-of-stocks situations was recorded. Improved merchandise availability greatly influenced sales performance, which in Metro Group's experience grew by up to 15-20 percent (although not completely attributable to RFID integration) (Metro Group, 2008)
- Improving Planogram and Promotion Compliance. In the grocery industry, retailers created planograms for each store often based on agreements with manufacturers showing how and where different products would be displayed. Retailers also made agreements with manufacturers about how and when the manufacturers' products would be promoted. Yet, stores often lacked the resources necessary to carry out so many events. RFID technology provides data on the location of products and hence improve both planogram and promotion compliance. These data, when shared with manufacturers, allow

manufacturers to observe whether their agreements were being executed at the store level

- Counting only the automated dock-door incoming goods processes, the Metro Group experienced the combined use of RFID and EDI resulting in total savings of €8.5 million per year in Germany.

ANALYSIS BASED ON PERFORMANCE

This analysis of the case studies based on performance dimension that include coordination and integration; information sharing; and cost. This entire performance dimension explained next.

Coordination and Integration

From the previous section (RFID in retail supply chains), the research identifies Wal-Mart to be implementing inventory management since 1983. Wal-Mart was provided with various advantages due to the implementation of RFID systems. The organization made several attempts to eliminate manual processes related to receiving, inventory management, shipping and payables. The firm was able to reduce inventory shrinkage and out-of-stock conditions due to the adoption of automatic product tracking practices and thereby reduce errors in data entry process. Hence, it is concluded from the case study that implementation of the RFID system does not result in inaccuracy in inventory management for normal business operations. Reduction of unproductive inventory and point-of-sale systems are the result of implementation of RFID and practices related to integration of RFID in VMI programs.

It is also identified from the previous section (RFID in retail supply chains), that implementation of RFID in Metro Group has impacts on inventory management and also considerably reduced the level of inventory inaccuracies.

Metro implements the RFID system in actual shelves that store the goods that are to be delivered or sold which is a very effective measure not seen in Wal-Mart stores. The shelves are known as Smart Shelves which includes an RFID reader that automatically tracks the products placed on it (RFID ARENA, 2012). The firm also makes efforts to implement an RFID system on pallets and case level tracking. The practice of automatic self-check outs is considered general practice in shopping activities in Rheinberg. It is also argued that the majority of the customers made use of the system at least once for making payments for their purchases.

Information Sharing

Another important performance measure which needs to be examined is the degree of information sharing. Wal-Mart is able to provide support for buyers, and promote the accuracy of purchasing forecasts by means of combining sales data and external information, such as weather forecasts. The firm was observed to experience more advantages by adopting RFID since more cases and products were tagged and more data was gathered (Al-Kassab et al., 2011). The data collected was used for promoting replenishment with regards to improved visibility which is provided by the RFID tags by Wal-Mart and its suppliers (Supply Chain Digest, 2009). There were also efforts made for addressing the privacy issues and problems faced by customers with regards to national legislation and guidelines of good practices. Such practices are given more importance by Wal-Mart when compared to Metro. There are combined efforts and attempts by Gillette and MIT Auto-ID Centre to protect the privacy of consumers. The technical specifications provided by Auto-ID Centre enable the consumers to disable the RFID tags at checkout counters after purchasing the product. Wal-Mart also provides services for immobilising the RFID tracker in Gillette products before they leave the store.

In 2008, Wal-Mart examined the Gillette products integrated with RFID in order to establish a smart shelf in a store located in Brockton, Massachusetts (Kasiri et al., 2012). It is also suggested that RFID provides flexibility for product recalls. The products that are integrated with RFID and EPC are able to determine each and every product that were sold from the store and make the recall process easier.

The major advantages which the research identified with respect to Metro Group are based on their practice of sharing information terminals which were firmly established by them (Future Store Initiative, 2006). This shows that there is an increase in the number of consumers making use of the service, from 51-58 percent. The Information Terminals also provide information related to origin and quality of food products. The main products such as eggs, meat, fruit and vegetables are provided with such services and practices. Hence, the Metro Group is considered to be the first retailer in Germany to implement such practices for customers and enable them to track the food products in accord with new EU directives (Future Store Initiative, 2006).

RFID technology provides amount of data for consumers and other suppliers. Based on the use of the data collected by such practices, the success factors for RFID are clear. The significant changes in the framework of the present system are recommended to make use of the data generated by such practices. The important factor to be observed with regards to the practice is the embedment of the RFID system within present information systems.

Cost

From the analysis of the previous section, the success of RFID implemented pull-based SC is evident with a reduction of 6.19 percent in overall inventory cost and an increase in overall inventory revenue by 7.6 percent, as described by Wal-Mart (IDTechEx, 2005). Due to the implementation of RFID, the savings made for each dispatch note by Metro Group was estimated to be €2.84. Savings in terms of cost and time are also determined by the automation services. The cost of downstream flows of physical goods and the upstream flow of demand information is found to be reduced when there is implementation of the RFID system by the organization.

Since 2004, the Metro Group was determined to implement In-store RFID in Future Stores. By the end of 2008, Metro Group was observed to increase the sales points in action to 200 and also included Metro Cash and Carry big supermarkets in nine central distribution warehouses. The firm also included most of the Real Warehouses and reduced overall costs by 15 percent (Metro Group, 2008).

CONCLUSION

The main purpose for performing this research study was to provide a detailed description about the impact of RFID technology on the SC performances of the world's key retail organizations. This was achieved by providing case studies of Wal-Mart and Metro group on challenges faced by retail businesses in the retail trading industry. Through the literature review, we have identified key SC performance measures including cost efficiency; collaboration; integration; information sharing; and inventory management. In addition, increasing cost expenditures and products cause the retailers to reduce costs and implement new IT solutions so that they may withstand competitive pressures in their businesses.

In stages, barcodes can be replaced by RFID on the basis of conditions of low price tags and hardware, international standards of common frequency of operation, accepted by numerous retailers and advancement in hardware and tag development in a number of retailing processes. RFID can also be used in warehousing, material handling, physical distribution, planning inventory control and order processing.

RFID technology in the field of retailing helps to mark out the moving objects in logistic networks. This chapter has made a between RFID technology implementation in Wal-Mart and Metro regarding its reading range and rate, read/write operations, identification, interference, improved efficiency in warehousing, cost performance and automation along with the incorporation of reading rates, data capacity, communication protocols, cost, and so on.

RFID can be used by various large retailer corporations such as Wal-Mart, as an electronic code to modernise the SC process. The advent of smart shelf indicates to the employees the need to replenish products immediately as they reach an out-of-stock condition. RFID assists in reducing the faults between inventory records and the physical records so that there is a significant improvement in the effectiveness of inventory management. The implementation of RFID in the progression of material handling equipment will increase the efficacy of picking process by up to 15-20 percent. In contrast, the implementation of RFID for point-of-sales can effectively reduce the time taken by a cashier and reduce the tail-back time.

In this research study, RFID implementation in retailing presents future trends for the development of a real-time knowledge-based system that has been used to support the performance of logistic processes by means of assimilating the decisions of workers with the help of agent technology along with RFID technology within the logistic operation settings.

Amalgamation of retail logistic operations with RFID technology will enhance the operational efficiency and functioning of logistic process within the retail industries. We suggest that other hypermarkets and supermarkets should adopt the trends established by Wal-Mart and Metro Group and try to implement RFID technology in their logistics operations.

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KEY TERMS AND DEFINITIONS

Automatic Identification Technology (Auto-ID): Auto-ID is a wide term given to a host of technologies that are used to help machines/equipment to identify objects/items. Auto-ID is often coupled with automatic data capture. That is, companies want to identify different items, capture much information about them and in some way get the data into a computer without having employees type it in.

Coordination: Coordination is the unification, and synchronization of the efforts of group members so as to provide unity of action in the pursuit of common goals. Management seeks to achieve coordination through its basic functions of planning, organizing, staffing, directing, and controlling.

Information Sharing: Information sharing referred to one-to-one exchanges of data between a sender and receiver. These information exchanges are implemented via dozens of open and proprietary protocols, message and file formats.

Integration: Integration is the act of bringing together smaller components into a single system that functions as one. In an IT context, integration refers to the end result of a process that aims to stitch together different, often disparate, subsystems so

that the data contained in each becomes part of a larger, more comprehensive system that, ideally, quickly and easily shares data when needed. This often requires that companies build a customized architecture or structure of applications to combine new or existing hardware, software and other communications.

Radio Frequency Identification Technology (RFID): RFID is a technology that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal, or person.

Supply Chain Management (SCM): SCM is the management of the flow of goods and services, involves the movement and storage of raw materials, of work-in-process inventory, and of finished goods from point of origin to point of consumption. SCM has been defined as the design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand and measuring performance globally.

Supply Chain Performance: Supply chain performance refers to the extended supply chain's activities in meeting end-customer requirements, including product availability, on-time delivery, and all the necessary inventory and capacity in the supply chain to deliver that performance in a responsive manner.