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Is There a Business Case for RFID?

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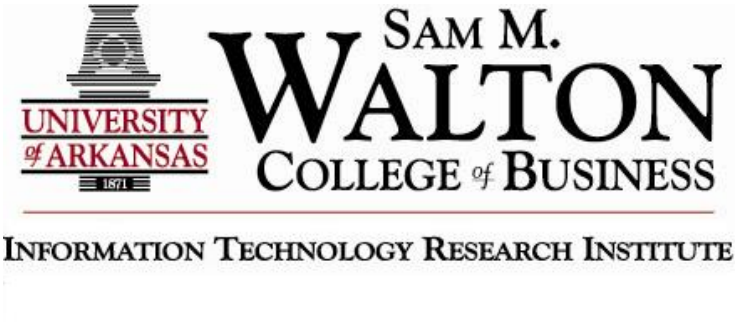

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Abstract

In June 2003, Wal-Mart asked its top 100 suppliers to begin using radio frequency identification (RFID) tags on pallets and cases beginning January 2005. Since that announcement, the business value of RFID in the consumer packaged goods supply chain has been periodically questioned. Recently, a *Wall Street Journal* article asserted that RFID is not living up to its hype, and in reality is not providing the promised tangible business value throughout the supply chain. In light of such claims, this paper examines the business value of RFID in the supply chain and presents a model of RFID assimilation which proposes that the creation of business value is dependent upon the depth of assimilation (extent of use). The model is grounded in industry observations of the difficulty of early adopters to fully realize the benefits of RFID assimilation. The model conceptualizes RFID assimilation as occurring in three waves: the first wave of the model is Technology Deployment, the next wave of Data Understanding, and, lastly, the final wave is Business Value Creation. In this paper, the first two waves of the model are explored briefly with the emphasis placed on proven business cases and potential opportunities for RFID to provide business value in the supply chain.

Keywords: Radio Frequency identification, technology assimilation, business value

Is There a Business Case for RFID?

Introduction

Radio frequency identification (RFID) is a form of automatic identification that uses radio waves to identify products. Because of its many advantages over barcode (the current standard for automatic identification), many retailers have begun the transition to RFID. Perhaps the most significant sign of this transformation was Wal-Mart's announcement in June 2003 of its intention to have top suppliers begin using RFID tags on pallets and cases by January 2005. The Department of Defense, Target, Albertson's, Best Buy, and others soon followed with their own RFID initiatives.

However, the transition has not been smooth. Many in the industry question the business value (i.e., ROI) of RFID. In a recent *Wall Street Journal* article (circa February 15, 2007) entitled "Wal-Mart's Radio-Tracked Inventory Hits Static," the reporter paints a rather dismal picture of RFID: grumbling suppliers, high costs, no return on investment, and reluctant retailers (McWilliams, 2007). In a similar article in *Computerworld* (June 15, 2006) the author states, "A few years ago, the IT industry was abuzz with the wonders of radio frequency ID technology. It was set to revolutionize everything about business process management. But in the past year, there have been few advances in RFID that would put it center stage" (Gittlen, 2006). If we are to believe the popular press, it would appear then, that the use of RFID is losing traction due to a lack of proven business value creation.

Contrary to these negative reports on RFID, we believe there is a business case for RFID. The use of RFID throughout the supply chain can provide manufacturers, suppliers and retailers unprecedented visibility. This newfound visibility provides many real and potential benefits, such as reducing out of stocks, properly executing promotions, and reducing theft. In this paper,

we propose a model of RFID assimilation which suggests that the creation of business value is dependent upon the depth of assimilation (extent of use). The model conceptualizes RFID assimilation as occurring in three waves: the first wave of the model is Technology Deployment, the next wave of Data Understanding, and, lastly, the final wave is Business Value Creation.

Model of RFID Assimilation

The three phases of RFID assimilation include technology deployment, data analytics, and business value (see Figure 1). The first phase involves creating an RFID-enabled environment, which includes the equipment, such as the readers, antennae, and tags. Deploying RFID technology alone will not produce business value. Instead, the technology produces data that, with proper analysis, produces information and insight that can produce business value. As we learn more about the data that is needed, the technology deployment can be improved; the more we learn about the business value that is being produced, the better idea we have about the data needed. Thus, the feedback loops in the model illustrate the need to update the technology deployment and data analytics, as necessary. In this paper, we focus on the last phase – Business Value – but keep in mind that one cannot get to the business value phase without passing through the two earlier phases (briefly described in the next sections).

Phase 1: Technology Deployment

Unlike other common automatic identification technologies, such as barcodes, RFID uses radio waves to communicate. Compared to barcodes, this offers several advantages, such as: (1) RFID tags are not constrained by a need for line-of-sight; (2) many RFID tags can be read simultaneously; (3) RFID tags can store information regarding the individual item; (4) RFID

works well in a dirty environment; and (5) RFID tags can potentially be written multiple times, making them reusable data containers (Raza et al., 1999 and Shepard, 2005).

In its simplest form, an RFID system consists of a tag (attached to the product to be identified), an interrogator (i.e., reader), one or more antennae attached to the reader, and a computer (to control the reader and capture the data). At present, the retail supply chain has primarily been interested in using passive RFID tags. Passive tags receive energy from the electromagnetic field created by the interrogator (e.g., a reader) and backscatter information only when requested for it. The passive tag will remain energized only while it is within the interrogator's magnetic field. Unlike passive tags, active tags have a battery on board to energize the tag. Because active tags have their own power source, they don't need a reader to energize them; instead they can initiate the data transmission process. On the positive side, active tags have a longer read range, better accuracy, more complex re-writable information storage, and richer processing capabilities (Moradpour and Bhuptani, 2005). On the negative side, due to the battery, active tags have limited lifetime, are larger in size and are more expensive than passive tags.

Companies currently have several options when implementing RFID. They can use static RFID portals which create a set read field at discrete choke points such as a dock door or sales floor door. Companies may also use mobile devices such as forklift readers or handheld readers. The choice of technology is dictated by the type of data one wants to capture.

Phase 2: Data Analytics

What RFID data does a company need to create business value? The current deployment of RFID includes only a small portion of the overall supply chain (specifically, retailer

distribution center and store backrooms) using static portals. Trends, however, suggest infusion across the entire supply chain and a move to more mobile devices and fewer static portals.

Given the current deployment, it is important to understand what data is available. A typical retailer distribution center would contain readers at the receiving doors, on the conveyor, and at the shipping doors (see Figure 2). Read points in a generic store include receiving doors, sales floor doors, backroom, and box crushers (see Figure 3).

An RFID tag contains an Electronic Product Code (EPC) which is a family of product codes, including such things as the serialized global trade identification number (SGTIN) and the serialized shipper container code (SSCC), among others. SGTIN is the standard identifier for cases of products and allows each case to be uniquely identified with a serial number. In contrast, the typical Universal Product Code (UPC) only provides information about the product but does not uniquely identify each case.

An example SGTIN is 0038010.150853.203. The first seven digits represent the manager number or company prefix. The next six digits represent the item number or object class. The number following the second period is the serial number. In this example it is only three digits, but the serial number can be up to 12 digits.

When the data is initially received, it will not necessarily be in a user friendly form. The first step of the data analytics is to filter and cleanse the data. The data may show many different reads for one case or pallet of product. Once the data has been filtered and cleansed, it should be integrated with the existing systems of the organization and then interpreted to decipher what the data means. Once the data is interpreted and understood, then actions may be taken that lead to the business value phase. An example of cleansed data with the four key elements of a read – EPC, facility, date/time of read, and reader location – is shown in Table 1.

Phase 3: Business Value - Proven

Ultimately, the true test for RFID is whether or not it creates business value. As described, the technology must be deployed and the data captured as precursors to creating business value. Although initial deployments are limited (partial supply chain, not all suppliers, not all products, etc.), benefits are already being found. Additionally, there are several potential benefits waiting to be tested. The real and potential benefits of RFID for the major supply chain participants – retail stores, distribution centers, and manufacturers – are summarized in Table 2 and examined in the following sections. As the realized benefits have been segment specific, there is potential for future benefits to cross multiple segments of the supply chain. The realized benefits are presented by major supply chain participant category while the potential benefits are discussed more holistically.

Retailer: Out of Stocks

Out of stocks is a major problem for retailers, suppliers, and consumers. Nationally, the average out of stock rate is about 8% (Corsten and Gruen, 2003), which means that about 1 out of every 12 items on a consumer's shopping list is not on the shelf. The result: lost sales and unhappy customers. Although retailers have tried to improve out of stocks for years, the 8% rate has remained relatively stable (Corsten and Gruen, 2003). One of the anticipated benefits of RFID was the reduction in out of stocks. To examine this benefit, in 2005, the University of Arkansas conducted the largest out of stocks study ever. The study included thousands of products in 24 stores of various Wal-Mart formats over a 6-month period. The initial results, released late 2005 (see Hardgrave, Waller, and Miller, 2005), were both positive and extremely encouraging. In the test stores (those that were RFID-enabled), out of stocks dropped 26% during the study period. This constitutes an improvement in out of stocks that was 63% better

than the improvement experienced in control stores (those that did not have RFID). A follow-up analysis based on the velocity of sales (i.e., daily sales per item) indicated that for those items that sold between 0.1 and 15 units per day, RFID was responsible for a 30% reduction in out of stocks (Hardgrave, Waller, and Miller, 2006). In some categories, such as those selling between 7 and 15 units per day, out of stocks were reduced by more than 60%! Ultimately, this translates into about a 1% sales lift for the retailer and 0.8% sales lift for the supplier. Is 1% important? Last year, Wal-Mart gross sales were $344.6 billion.

Retailer: Manual Orders

In retail stores, store associates will often create a manual order for a product if it cannot be found in the backroom (although it may be there). Unnecessary manual orders affect perpetual inventory accuracy (as the product inventory count is often set to zero before placing a manual order). Unnecessary orders also send false signals up the supply chain about the current demand for product, thus creating the bullwhip effect (Lee, Padmanabhan, and Whang, 1997). The bullwhip effect has adverse effects on both the supplier and the retailer. With RFID, Wal-Mart has reduced the number of unnecessary manual orders by 10% (Sullivan, 2005).

Retailer: Promotion Execution

RFID has proven to be an effective tool for improving promotions (Collins, 2006; Murphy, 2005). In February 2006, Procter & Gamble launched a new product and promotional campaign for the Gillette Fusion razor. As a part of the promotional campaign, Procter & Gamble tagged the Fusion promotional displays in addition to tagging the cases and pallets. They were able to determine if the retailer had placed the promotional display on the floor in a timely manner to correspond to the promotional launch. Additionally, they could assess whether a store had restocked the razors on the sales floor. By having this information, Procter &

Gamble was able to either send their own personnel to the retailer or prompt the retailer to restock or put the promotional display on the sales floor. According to Collins (2006), "…improving promotions proved to be an even greater 'sweet spot' for the technology within the company."

Distribution Center: Receiving

Early evidence suggests that RFID can reduce the amount of time to receive product at a warehouse (Katz, 2006). Instead of scanning each case of product individually with a barcode scanner, RFID tagged product can be read automatically at a dock door portal. Gillette reported a reduction from 20 seconds to 5 seconds in pallet receiving at their distribution center due to RFID (Katz, 2006). The process of receiving was not drastically changed (i.e., forklifts unloaded the product as before). The only change was eliminating the need to manually scan the product. Thus, the process became more efficient.

Distribution Center: Electronic Proof of Delivery

RFID can reduce the errors in receiving (in addition to increasing the speed of receiving as previously discussed) via the RFID-enabled process referred to as electronic proof-of-delivery (or ePod) (Mason et al., 2006). With barcode, mistakes are made by misidentifying the quantity and type of product. For example, a pallet of 48 cases of shampoo consisting of 24 regular and 24 scented may be received at the distribution center. The receiving clerk mistakenly identifies the pallet as 48 cases of scented shampoo. Thus, the inaccurate receiving creates an inventory inaccuracy for the receiving company and a perceived overage/underage situation for the supplier.

Manufacturer: Asset Management

With RFID, manufacturers have the ability to better manage their movable assets, such as forklifts, equipment, expensive tools, etc. For example, the University Medical Center in Tucson, Arizona has implemented an RFID asset tracking system for all 2,300 pieces of mobile medical equipment. The location of each piece of equipment within the 8-story hospital is transmitted wirelessly and can be displayed on a virtual map (Philips Launches …, 2006). Now, equipment can be found anytime anywhere; thus, avoiding time loss in locating equipment in emergency situations, for example. Obviously, similar projects in other industries, such as tracking forklifts in a warehouse, are feasible and potentially valuable.

Manufacturer: Product Life Cycle Tracking

An example of product life cycle tracking is the use by Michelin to keep track of large industrial tires to know when they need to be retreaded (Murphy, 2005). RFID can be used to monitor the life cycle of the product, thus improving safety for the truck drivers and enhancing the relationship with the customer.

Phase 3: Business Value - Potential

Recall Management

With barcode, retailers have no idea where (i.e., which stores) the recalled product is located. Thus, they are forced to look at each store and perhaps pull the product from the shelves at each store. With RFID, cases could be tracked to particular stores. Similar to retail stores, distribution centers and manufacturers would be able to track product at the case level with RFID. A recent occurrence was the pinpointing of the tainted raw material product shipment from China to manufacturing plants which produced poisonous dog and cat food. As recent as April 19, 2007, the Food and Drug Administration has expanded the recall of pet foods due to

the tainted wheat gluten and rice protein concentrate imported from China (Pet food recall, 2007).

Product Rotation

RFID data can provide the visibility needed to know whether or not product is being rotated properly (using the first-in-first-out (FIFO) method, for example). Consider the wide variety of products that have expiration dates or are perishable. This insight can, thus, help ensure proper rotation in both the retail store and the distribution center to get the product which expires/perishes the soonest, to the front of the shelf/display.

Shipping Accuracy

Distribution centers and manufacturers often make mistakes by loading product on the wrong truck. With RFID, the system could send an alert (visible, audible, etc.) to the person loading the truck that a mistake was made. This alert could save a company money from shipping and reshipping the same items as well as enhance inventory control.

Inventory Accuracy

The key to good forecasting and replenishment models for the retailer is accurate inventory. Unfortunately, inventory counts (commonly called perpetual inventory) which are calculated by subtracting point of sale from the amount of product received, are inherently wrong. A recent study (Raman, DeHoratius, and Ton, 2001) found that as much as 65% of all perpetual inventory counts are wrong. Thus, forecasting and replenishment models are based on data that is wrong 65% of the time! RFID could provide much better data to determine accurate inventory counts.

Shrinkage

Shrinkage is any loss of product as it goes through the supply chain whether through damage, spoilage, loss or theft. Although RFID cannot eliminate all shrinkage, it can help reduce it with the visibility it provides. For example, a company may know what 5% of its product is disappearing in the supply chain, but have no idea where (retail store or distribution center). RFID would provide the insight into where it was last seen so that a company could determine (for example) that the product made it to the store but never to the shelf (which may suggest that employees were stealing the product). Another example could be of a manufacturer of a seasonal product that shipped 10 cases of the product, but only 9 cases appeared at the store. With bar code tagging, once the product leaves the manufacturer the location of the product within the supply chain is unknown. However, with RFID, quick identification and location of the lost product could provide time and cost savings and ultimately business value.

Reusable Containers

Many manufacturers ship their products in reusable containers, such as milk crates, reusable totes, bins, rolling shelves, etc. Unfortunately, these containers have a tendency to disappear. Each container could be tagged with RFID, thus similar to the shrinkage discussion the manufacturer would know where the container was last seen.

Targeted Use of Merchandisers

Many suppliers send merchandisers to retail stores to bring product from the backroom to the sales floor. Currently, merchandisers methodically work from store to store (perhaps having responsibility for 20 or more stores). Some stores will have merchandise in the backroom and a need to work it to the shelf, others will not. Visits to those stores that do not need it represent a waste of time for the merchandiser. With RFID, the merchandiser could remotely determine

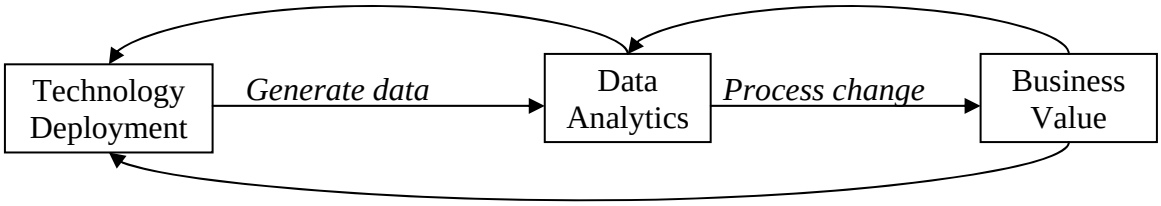
(from their home office, for example) if product was in the backroom and if it needed to be placed on the sales floor shelf.

Conclusion

This paper has identified three stages of RFID assimilation: technology deployment, data analytics, and business value. The primary focus of the paper was to illustrate proven business value and potential value that companies could glean from using RFID. We have demonstrated the proven business value of RFID by giving specific examples for retailers, distribution centers, and manufacturers that have previously been experienced. Additionally, we identified seven potential benefits for the retailer, distribution center, manufacturer or some combination of the three that is possible with RFID. Some business value from RFID used to improve promotion execution, asset management and electronic proof of delivery has already been achieved by many companies (e.g., Wal-Mart, Gillette, Michelin, and Proctor & Gamble). We assert that the identified and unidentified (due to future technology improvements not yet available) potential benefits will expand the business value companies throughout the supply chain receive from RFID.

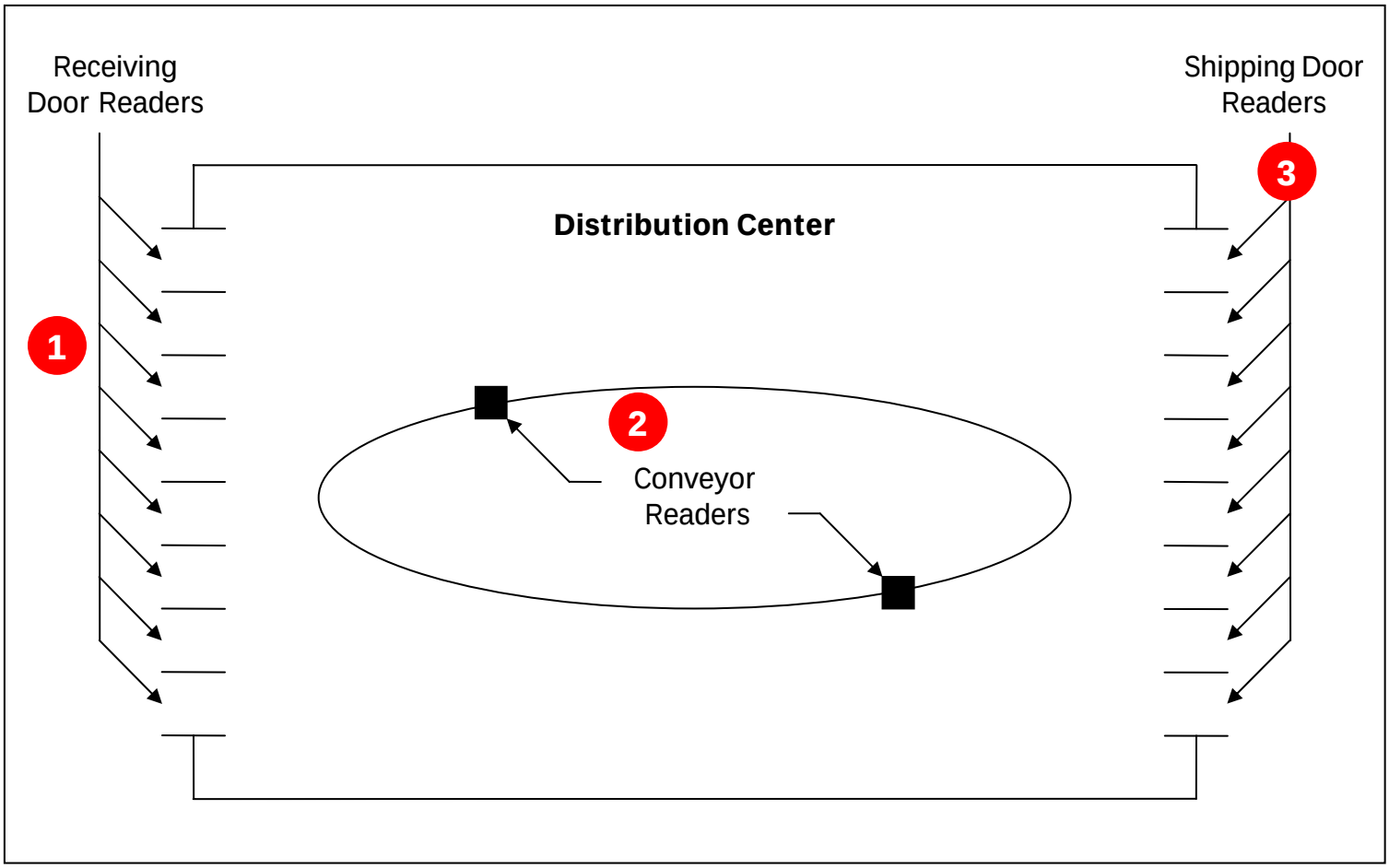
RFID Framework

Figure 1



Case Movement through a Distribution Center

Figure 2



Case Movement through a Store

Figure 3

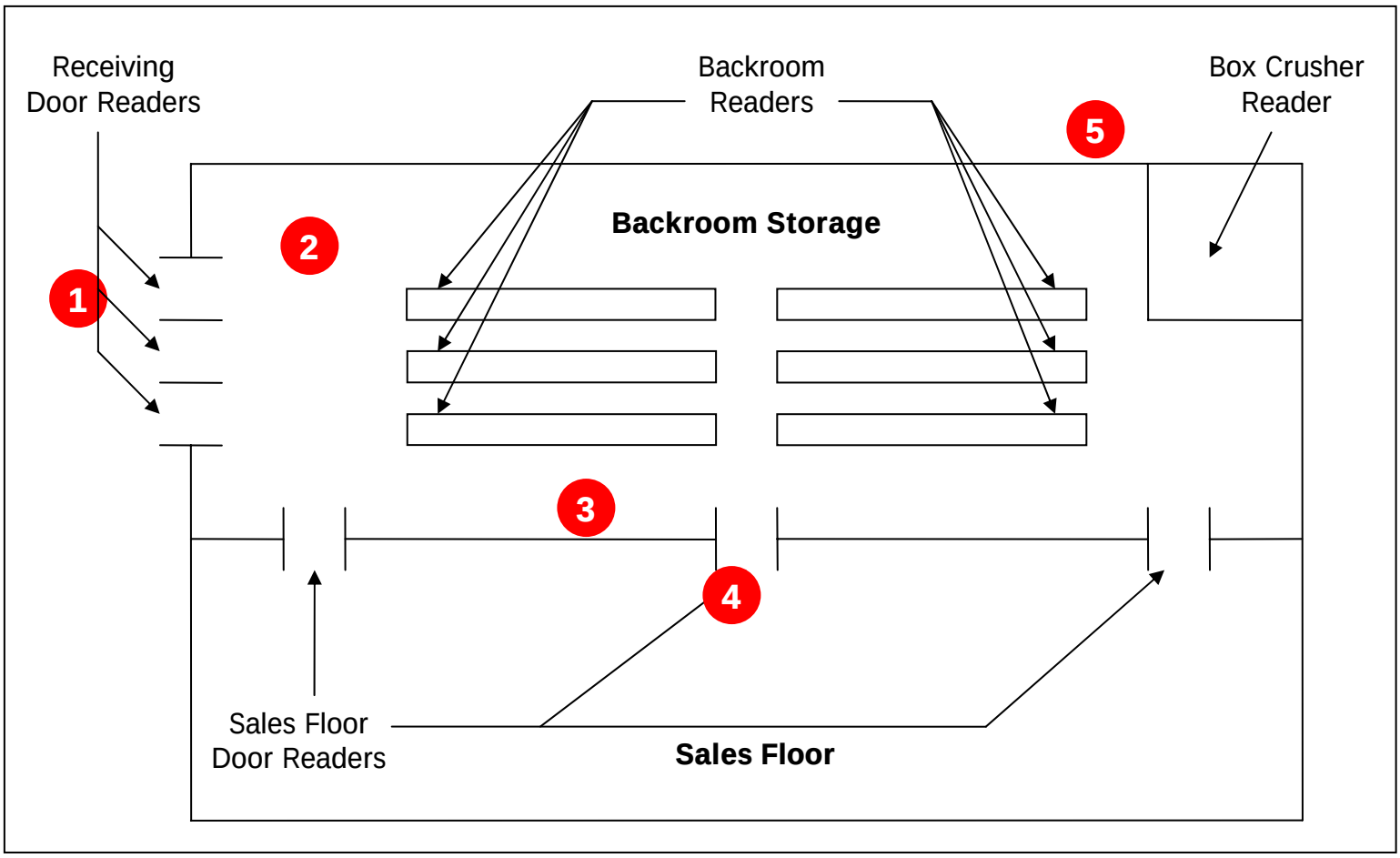


Table 1. Sample RFID Data

Facility	EPC	Date/time	Reader
DC 123	0038010.150853.203	08-04-06 23:15	inbound
DC 123	0038010.150853.203	08-09-06 7:54	conveyor
DC 123	0038010.150853.203	08-09-06 8:23	outbound
ST 987	0038010.150853.203	08-09-06 20:31	inbound
ST 987	0038010.150853.203	08-10-06 1:12	backroom
ST 987	0038010.150853.203	08-11-06 15:01	sales floor
ST 987	0038010.150853.203	08-11-06 15:47	sales floor
ST 987	0038010.150853.203	08-11-06 15:49	box crusher

Table 2. Business Value for RFID: Real and Potential

	Retailer	**Distribution Center**	**Manufacturer**
Proven business value	- out of stocks - manual orders - promotion execution	- receiving - electronic proof of delivery	- asset management - product life cycle tracking
Potential benefits	- shrinkage - inventory accuracy - product rotation - recall management	- recall management - product rotation - shipping accuracy	- recall management - shipping accuracy - reusable containers - targeted use of merchandisers

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