

Implementing RFID technology in small businesses

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Abstract

Many large companies in the U.S. have adopted RFID technology to improve the performance in their operations and supply chains. In comparison, few small companies have adopted this technology. This paper investigates the causes for the disparity and recommends areas where small companies may use RFID to make gains in performance and profits.

1. Introduction

Analysts estimate that U.S. retailers lose up to \$ 50B a year due to theft, and up to ten times the amount because of counterfeiters (10). High-end products such as cosmetics, perfumes, and medicines are most likely to be stolen or counterfeited (10). Many retailers and manufacturers believe that this serious problem can be solved through using RFID Smart Tags (10). RFID is the modern version of barcodes that were used in the past, to identify items for inventory control. Unlike barcodes that need to be scanned and read manually, RFID uses a silicon chip that does not need to be set up in a straight line with the emitter, but instead it emits a wireless signal within a certain range and makes it easy to identify the items inside the store (1).

2. RFID application in big companies

Many large companies and organizations have adopted RFID technology. The U.S. Department of Defense, Wal-Mart and Sam's, along with some other retailers, now require that their suppliers tag shipments with RFID so that the data can be automatically recorded when goods arrive (11). The inventory levels in large companies is very huge, therefore it needs more labor and time to handle and maintain, which is considered "waste" under Lean principles. Inventory can be significantly reduced by using RFID technology, which automatically tracks

the level of inventory and what should be ordered next, by using a silicon chip and an electronic device which can read the information stored in the chip. RFID reduces the chances for human error which can result in significant cost and savings. Large companies such as Wal-Mart (18), JCPenney (9), and others have adopted RFID technology to better manage their inventories along the supply chain, and have realized major gains in inventory control and investment.

In the following section, the writers discuss how companies such as Wal-Mart, Dillard's and J. C. Penney's have used RFID technology to improve their operations and supply chains.

2.1 Wal-Mart

Wal-Mart has expanded its use of RFID in recent years. Since 2005, Wal-Mart has required its top 100 suppliers to use RFID tags on pallets and cases until January 2007, 600 suppliers of Wal-Mart had applied the RFID technology in their shipments to more than 1000 Wal-Mart stores (13). The direct benefit of using RFID is the reduction in out-of-stock (OOS) items. Wal-Mart reported that 100,000 extra trips could have been avoided, if they have items on the shelves for the 24 million customers per day, resulting in \$22.8 million gas savings per year for costumers (19). The University of Arkansas conducted a six-month study on Online Operating System (OOS) in 2005. The research consisted of scanning thousands of items in 24 Wal-Mart stores, half of which were equipped with RFID systems. Results showed that for stores with RFID the OOS was reduced by 26% during the research period (5). A further research study in 2006 stated that items that were that sold between 0.1 and 15 units per day, RFID had reduced 30% in OOS; while some items that were sold between 7 and 15 units per day, RFID contributed to more than 60% OOS reduction (6). In all, these reductions in OOS were estimated at 0.7% sales increase for the retailer (7). Savings amounted to \$2.4 billion when considering the annual sales of Wal-Mart was \$344.9 billion during 2006 (17).

Another application of RIFD has been used by Wal-Mart to improve its inventory visibility. Inventory associates will generate a manual order for an item if they can't find the item in the backroom even the item may be in somewhere else. The inaccurate information of physical inventory will lead to an unnecessary manual order, and thereby the bullwhip effect as the inaccurate order information transfers along the supply chain. A field experiment was conducted by Hardgrave, Aloysius, and Goyal in a major global retailer for over 23 weeks regarding the visibility of the inventory (4). The experiment indicated that the RFID-equipped stores achieved a sharp deduction in inventory record inaccuracy (IRI) by 26%. In the follow-up study, research showed that RFID could also alleviate the effects of the proven determinants of IRR. It was written by Sullivan, that Wal-Mart was able to eliminate 10% of its unnecessary manual orders with the help of RFID (14). Wal-Mart reported that 10 years ago the company held \$19 billion in inventory for sales of \$150 billion. Last year, Wal-Mart's sales increased to \$250 billion, while only adding \$14 billion in inventory, overall contributing to the company's ROI by 19.3% (18).

Previous cases have shown the significant benefits of RFID in the pallet and case levels, in terms of reducing out of stock items and improving inventory accuracy. It is reasonable to assume that item-level RFID would bring more benefits, considering the fact that the apparel retailer's inventory inaccuracy can be as high as 55% according to the previous study (2). The following two cases render more supports to this assumption.

2.2 The Dillard's RFID Initiative

A study by University of Arkansas in 2009 was conducted in an apparel retailer, Dillard's Inc. Specifically; the study included the impact of item-level RFID tagging on the aspects of inventory accuracy, out of stocks, cycle counting, and loss prevention (3). During the 10-week study, inventory counting was conducted on both the sales floor and in the backroom of two

RFID-enabled stores that sold denim jeans, as well as, two control stores. In the result, the inventory count generated by RFID was compared to the system count Perpetual Inventory (PI). The benefits of RFID in the two test stores showed 17% inventory accuracy gain at the point of complete inventory counts, in the sense that the inventory count equaled PI, and the improvement continues to climb by 4% in the post RFID period when the impact of RFID on modifying the PI was tested. By contrast, the control store achieved a 12% improvement which was wiped out by the 13% decrease in the post RFID period (3). The study also concluded that the RFID could continuously reduce the gap between the actual OOS and PI, thus eliminating the OOS finally. Also, through comparing the efficiency cycle between the RFID and a barcode scanner, they used the same store and 1500 identical items. The result of this comparison indicated that it took 5.5 minutes for RFID to finish the counting while barcode scanning took 2 hours and 18.5 minutes (3). Moreover, the study proved the ability of RFID enabled doorways to read the items passing through almost in 100% cases (3). This ability allows the retailer to know what, when, and where was stolen.

2.3 The JCPenney's RFID Initiative

In 2010, another research project was conducted by the University of Arkansas, on item-level RFID tagging. This 15-week study was executed in apparel departments within two different test stores where RFID was used, and 3 control stores where the simple barcode was used. The results were that without the continuous adjustment by RFID, the inventory accuracy in the control stores tended to fall by 4.48% in the post RFID period. In the test stores, on the contrary, the inventory accuracy still increased by 2.62% (9). Therefore, the real benefit of RFID was 7.10% (2.62%+4.48%). Similar results were found when comparing the two departments

separately (9). This study justified the potential benefits of RFID even when a retailer had high initial inventory accuracy. In the next section the writers discuss the limited use of RFID in small companies.

3. RFID attempts in small companies

As opposed to the large companies, very few small companies have adopted RFID (16). Some small companies have implemented RFID in pilot projects such as in item tracking (8, 16). In this section the writers discuss how companies such as Applied Computer Technologies and Argo Wireless enable the application of RFID technology in small companies in their operations.

3.1 RFID pilot project

A company that provided services to health organizations carried out a low-cost pilot of RFID supported by a local systems integrator, Applied Computer Technologies. In the pilot run there was, one stationary reader, four antennas at the building's entrance gate, a RFID handheld reader, and approximately 100 RFID tags used to track the movements of the company's equipment between different locations. The total cost of the system was about \$5000, including hardware and software which were \$4000, while the cost of each tag was only about 15 cents (16). Once installed, the system allowed the company to record when, what, and where the equipment moved to, in and out of the company and the employee could easily find the tagged equipment in the crowded storage room by entering the item's RFID number. Although the company did not use that system, because of the requirements of the more complicated functions, the pilot still provided enough confidence to the small and mid-size companies that use to think the RFID was beyond their financial capability (16).

3.2 RFID in logistics

A study on the real operations of a container company, gave us more insight in the potential benefits of RFID in small 3PL (third party logistics) providers. It was reported that the manual labor was reduced by 50%, and operation error was decreased by 10 to 15 percent by attaching UHF EPC Gen 2 RFID tags in each contained to be shipped (8). Thus, the time needed for organizing a container of shipment was 36 minutes and 30 seconds with RFID as opposed to 160 minutes for traditional method without RFID (8). In the following cost analysis, a detailed ROI was calculated based on the average shipment of 30 to 40 containers per week, at the study time. Considering the local wage rate of \$26.05, the savings on labor cost based on an annual shipment of 1600 containers would be \$85,508.80. The estimated investment of RFID system in the studied office which was generated from a preceding pilot project was \$172,200. Thus, the ROI of RFID implementation was about 2 years (8).

3.3 RFID provider for small companies

Other exciting news came from the company Argo Wireless, which provided small and mid-size manufacturers with their new designed, affordable, item-level tagging RFID system. The system, known as SourceTag, consists of EPC Gen 2 RFID labels, various reader stations for different functions, a middleware, as well as, the EventLogix software to process and store data collected from the reader. The intended application of the system is to set up reader station in packing and shipping process, thereby achieving data collection both in item tagging in packing station and carton and pallet tagging in shipping process (15).

3.4 Cost justification for small companies

A case study by Mark Roberti, who is founder and editor of RFID journal, has discussed the benefits of RFID for small companies more convincing. Let us suppose there are two stores,

store A and store B. Store A uses barcodes which cost half of a cent each, and store B uses RFID chip which cost 10 cents each. Let us say that inventory accuracy in both stores is 98%. So, they will conduct inventory twice daily (12). Let us suppose the labor cost is 10 dollars per hour in table 1:

Number of items in store	20,000
Number of items sold in a year	200,000
Cost of Barcode	\$0.005
Cost of RFID	\$0.100
Inventory accuracy	98%
Labor cost	\$10 /hour

TABLE1. Cost assumption for barcode and RFID

We have considered two cases for Store B for RFID chip, i.e. 10 cents each and 15 cents each just for comparison in table 2:

Stores	Store A	Store B (10 cents)	Store B (15 cents)
Cost of technology	100	2000	3000
Number of workers	2	2	2
Number of hours	10	2	2
Total cost of technology/year	1000	20000	30000
Labor cost	36,500	7,300	7,300
Total cost	37,500	27,300	37,300

TABLE2. Cost calculation of RFID based on different unit cost of tags

Looking at the small picture, it seems like the cost of RFID (\$30,000) is far greater than Barcodes (\$ 1000). But with the addition of labor cost, store A would lose a significant share of its profit (in this case about \$10,000). Even if the RFID chip only costs 15 cents, the store will still have some profit, however due to the small inventory the chip is still costly for a small company.

It is shown through research that only a few companies conduct inventory on regular basis. Most of them conduct it two times a year because of the high cost of labor. Which is the main factor relating to the companies approximately 65% inventory accuracy (12). Since

American Apparel began employing RFID to take inventory in stores, it was found that their sales increased by 14% (12).

Now let's say you're Store C. By installing an RFID system and taking inventory twice a day, you could boost your sales by 14 percent. That's an additional 28,000 items, assuming 200,000 items were sold annually before you implemented RFID. At an average selling price of \$10, you would make an additional \$249,900 every year (\$280,000 in additional sales, minus \$27,300 for RFID tags and labor on the original 200,000 items, and \$2,800 in tags for the additional sales) (12).

As a real example for Return on Investment (ROI) on RFID implementation, Serge Blanco, a maker of high-end clothing well-known in France attached EPC Gen 2 RFID hangtags to the garments in its distribution center to process incoming and outgoing shipments. With only two people equipped with RFID reader, the receiving department was able to handle 35,000 items within 2 hours. The RFID system cost the company \$225,000, and the ROI of it was estimated to be less than 3 years (20).

4. Recommendations

The possible application area of RFID technology for small companies could be inventory management, product life cycle tracking, transportation management, promotion execution, and so forth. As shown in various case studies and research, even though the costs of RFID chips are more expensive than barcodes, the saving in labor cost is incredible. It is well known that the installation cost of RFID technology is high because of the system requirements along with the reader, intermediate software. However, the increase in sales and the significant reduction in labor cost will compensate the cost well. As indicated in our research and case studies, small companies should use cheaper RFID tags which start at 5 cents. Even the 10 cent

and 15 cent tags save the labor cost as shown above. As labor cost has increased by significant amount; the \$10 dollar an hour is not an option these days.

From a broader supply chain perspective, it makes sense for small companies to incorporate RFID technology, both upstream and downstream. Ideally, small companies can collaboratively implement the RFID pilot run and share the cost of RFID tags with their suppliers and customers (logistic service providers, wholesalers or retailers). Then experience gained through the implementation can be shared among the supply chain partners. The idea of sharing the risk, cost and experiences associated with the implementation of RFID can be realized through the activities like alliance development when establishing long-term strategic supply chain partnerships.

Besides, many suppliers are willing to integrate their customer's inventory data into their system for the ease of demand forecast and logistics management. The resulting Vendor Managed Inventory (VMI) is also an excellent opportunity to implement RFID in small companies. Big suppliers could take over the major cost the RFID application based on the consideration of long-term benefits and the convincing performance of small companies.

Before implementation, small company are required to decide which items need to be tagged as well as the level of tagging based on their business requirements and company strategy. Small companies can make the decision of tagging through the ABC classification of their inventory. Once the items to be tagged is decided, small companies can start their RFID experience by using the cheap passive RFID tags on the expensive or fasting moving items at a pallet level or case level. With the experience of using RFID accumulated through the daily operation and ROI of RFID demonstrated by periodical financial statement, small companies can move further to implement a more integrated RFID system.

5. Conclusion

RFID not only reduces theft reduction, but also significantly reduces labor and time and increases the efficiency of the small companies by supplying the right inventory at right time in right proportion. It provides real-time visibility of RFID-tagged items and helps small companies in managing and tracking them to get an edge over their competitors. The adoption of RFID technology in small companies will also encourage large companies in improving the internal, as well as, external supply chain along with the significant increase in the profit for all the companies embracing last tier of supplier to the end users.

The future trend of the supply chain is the expansion of the supply chain, increasing the responsiveness of the supply chain, the greening of the supply chain, and the cost reduction of the supply chain (21). There will be no exception for small companies under the influence of the development of the supply chain. All these can be efficiently achieved by capabilities enabled by the adoption of RFID into the supply chain.

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