RFID Implementations – Business Process and Technology Lessons Learned, Recommendations and Best Practices for New Adopters

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Abstract

This thesis focuses on documenting learnings from a RFID data exchange pilot in the fast moving consumer goods industry. The pilot we studied is a collaborative effort between two of the largest retailers in the world and five of their major suppliers, facilitated by EPCglobal and the MIT Auto-ID labs. Currently, manufacturers and suppliers are building the infrastructure to exchange EPC data to validate standards and proof of concepts for RFID adoption. The outcome of these pilots will essentially set the stage for large scale RFID adoption worldwide. Our thesis attempts to document issues relating to data exchange from business process, organizational and technical perspectives. We have synthesized the findings and consolidated the lessons learned during the pilot in an attempt to form a set of actionable recommendations for new companies looking to start on RFID pilot projects.

Acknowledgments

We would like to thank our advisor, Stephen Miles, for his support and encouragement throughout our research effort. Steve worked closely with us in validating our hypotheses, facilitated our interactions with partner companies and gave us constant support and guidance at critical junctures. We feel privileged to have had the opportunity to work with the Auto-ID center at MIT.

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1 Introduction

The advent of RFID technology was widely heralded as an opportunity for companies that were constantly looking to improve efficiencies and decrease costs. In many ways, it was the rendition of Victor Hugo's immortal lines – "The power of an idea whose time has come". The vision of RFID for supply chains encompasses creating an 'Internet of Things', a virtual network through which companies can track and trace items and obtain real time inventory visibility. If this vision is indeed realized, companies could fundamentally transform how they manage product and information flows across their supply chains.

Though the underlying technology behind RFID was first deployed to identify friendly airplanes in World War 2, it was not until the late 1990s that the idea of using RFID chips to tag items and create a global network to facilitate data exchange had its genesis. The pioneering work in this area came from the Auto-ID Center at MIT. Subsequently, the MIT Electronic Product Code (EPC) system was licensed by EPC Global, Inc, the standards body created from an association of bar code standard bodies around the world to lead the adoption of the RFID network.

Since RFID has applications in a variety of industries, several tag specifications and frequencies have evolved to meet the requirements of specific industries. The Fast Moving Consumer Goods (FMCG) industry consisting of retailers and suppliers has been at the forefront of driving the adoption of the MIT Auto-ID EPC reader and tag specifications. The Ultra High Frequency (UHF) standard has been adopted within the FMCG industry for tracking the movement of cases and pallets in the supply chain.

The EPC Global organization is organized into Business Action Groups that identify end user business requirements which define technology requirements to pilot or test out various aspects of RFID development like data exchange, hardware and software systems. These pilots are opportunities for companies to identify at a granular level the operational issues, the value proposition and business case for Ultra High Frequency (UHF) RFID in their supply chains. These pilots are an invaluable source of learning for many companies as they attempt to transform RFID from a concept to reality.

This thesis attempts to capture some of the lessons learnt by FMCG companies during their pilot implementation of the first standardized RFID data exchange based on the upcoming EPC-Information Service (EPC-IS) specifications. Two of the largest retailers in the world and five of their major suppliers came together under the aegis of the EPC Global FMCG Business Action Group (BAG) to develop, standardize and test data exchange across supply chain partners. The FMCG BAG data exchange pilot project represents the first time that two of the largest retailers on the planet have communicated supply chain information in a common machine readable format. This thesis tries to consolidate the lessons learnt during this pilot project into a set of actionable recommendations and tips for new companies looking to start on RFID projects.

Considerable literature exists today on hypothetical value propositions for RFID. However, few get into the level of detail required to analyze exactly how value will be created. For instance, there are many reports which highlight how the benefits of RFID will come in the form of reduced inventory, improved forecasts, reduced stock-outs and labor savings. All these value propositions are reasonable. However, it is not clear what RFID business processes a company has to implement to achieve reduced inventory or any of the other intended benefits. If it has an inventory management system in place currently, would reorders be triggered any differently? What data would be required for the safety stock to be calculated differently? At what point and in what form will this information be conveyed? For new adopters of RFID systems, these questions can be intriguing. The EPCglobal FMCG BAG Data Exchange Work Group (WG) was organized to establish business requirements for the use and exchange of EPC-related data between trading partners and to determine and communicate the scope of standardized business processes for EPC data exchange. The resulting pilot project analyzed in this thesis attempts to validate and answer many of these questions. This experience can be of tremendous help to companies looking to start pilots themselves.

RFID may well be classified a 'disruptive technology' impacting most business processes across the company and touching data from many areas of an enterprise. The lessons learned from the Data Exchange Pilot WG pilot correspondingly span many boundaries like hardware, software, business process, infrastructure, data exchange and so on. However, issues revolving around data integration have arguably been the most critical for companies since data is crucial to inventory visibility and process automation, two of the most significant anticipated benefits from RFID. The scope of our thesis effort is guided largely by business process and technology related lessons from the FMCG BAG WG pilot involving Data Exchange and Data Management.

In the course of this pilot it has become quite evident that RFID is not a 'one-size-fits-all' technology. The challenges and benefits from RFID adoption are specific to each supply chain, company, division, product line and SKU. The cost of tags has for a long time been deemed the most significant impediment to large scale adoption. During the first few pilots, companies also saw the reliability of read rates as a significant challenge. However, early results from the Data Exchange WG pilots indicate that both these hurdles may not be insurmountable. Suppliers are learning to align their business processes around products that lend themselves to RFID adoption (referred to as RFID 'advantaged' products[1]) while tag read rates have shown constant improvement. Retailers have also devised business processes that circumvent the read reliability issue. Some examples include tagging items at source and consolidating pallet level data at the time of pallet construction rather than attempting to read every case on the pallet simultaneously. However, meaningful data exchange within and across company boundaries still remains an elusive goal. The key issues here have to do with standards, interoperability and protocols.

The EPC Global FMCG BAG Data Exchange Workgroup consisting of FMCG retailers and manufacturers initiated Phase 1 of a pilot project in 2005 to test the (Electronic Product Code Information Service) (EPCIS) standard interface for data exchange as well as standard data elements and values (business vocabularies) developed in the BAG for describing a typical supply chain workflow. In order to ascertain the utility of the defined business vocabulary steps, it was necessary to dive deeper into value propositions for RFID. Shipping and Receiving and Inventory Visibility were two established business cases that the pilot group decided to use to validate findings in the initial pilot. Inventory Visibility holds the promise to facilitate real time decision support and efficiency increases across supply chains. Shipping and Receiving was intended to drive automation and labor savings across the supply chain. As the pilot progressed,

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[1] IBM for Grocery Manufacturers Association (2006, Apr). EPC/RFID: Proposed Industry Adoption Framework. Manufacturer Survey and Pilot Learnings to Date

suppliers saw potential advantage in tracking Promotional Execution and New Product Launch of high value tagged items to validate the benefits of inventory visibility. Therefore, this thesis focuses on the business case for Inventory Visibility and Shipping & Receiving processes and the associated learning around implementing them during the pilot.

What became quite evident during the pilot was that a middleware technology infrastructure needed to be developed to process the exchange of shared business process data and that this data needed to be placed in some business context to realize business value. For instance, a company would have to be able to parse EPCIS schema, the data representation specifications developed by EPC Global Software Action Group (SAG). It would then have to store this data in some information model that is designed to integrate this data with associated business transactions, or develop data integration middleware/Enterprise Service Bus (ESB) that could perform this service across multiple databases. It would then require an infrastructure to support queries across this information that ask questions like 'what read events for product y have been seen between time a and b at location x'. Hence, one of the aspects of documenting the learnings of Phase 1 of the pilot is to understand how companies designed their data processing infrastructure for the pilot. The issues involving queries will be addressed in depth during the subsequent phases of the pilot.

Linkage between RFID data and enterprise software system transactions is critical. Otherwise, RFID runs the risk of remaining isolated at the periphery of supply chains. One challenge is that legacy enterprise software systems dealing with supply chain information and the Global Data Synchronization Network portals that synchronize supplier information with their retail partners use Serial Shipping Container Codes (SSCCs) or GTINs, as are represented in the bar code, compared to the EPC numbers which are read by RFID systems. Hence, companies need to create a capability to map and/or convert data between RFID data capture systems and enterprise databases. Issues like data parsing, data models, middleware processing and data communication play a key role here. The complexities also vary depending on whether a single large database centric approach is taken or whether a Services Oriented Architecture is used to access data from distributed data sources to facilitate data integration. Since RFID data increases the volume of data transmissions, planning for network performance, scalability and reliability of the data exchange assumes additional importance as data volumes grow.

Clearly, there is a lot that one can learn from trying to implement these different approaches in pilot programs. Even if companies have not devised best practices yet, a basic understanding and acknowledgement of issues involving RFID data capture, storage, retrieval and exchange of meaningful RFID and associated data can make a big difference to the planning efforts of new adopters. It is our hope that the lessons and recommendations that we are documenting through our thesis add value to these efforts.

2 Literature Review

Many studies have documented the vision of using Radio Frequency Identification to drive value across the supply chain. While the promise articulated in these studies is more valid now than ever before, companies are moving beyond theoretical proposals to implementing pilot projects that validate some of the claims. A growing area of focus for both the retailers and suppliers involves effectively handling the vast amount of data being exchanged and re-evaluating their business processes and decisions based on the exchanged data. Previous literature examining data exchange can be logically sub-divided into two groups – Technology and Business Process.

Wang and Liu (2005) evaluated the data management aspect of managing time-dependent, dynamically changing and large volume RFID data that carry implicit semantics. They touched upon areas like RFID object containment queries, rules based data transformation and efficient query support with partitioning. They proposed a dynamic relationship based entity data model that integrated business processes into the data model itself.

EPCGlobal's Electronic Product Code Information Service (EPCIS) standardization effort involves specifications for a common data model / schema that could be used by both retailers and suppliers to exchange data. Within the area of using Web Services, Violino (2003) examined aspects of linking RFID with Web Services to facilitate RFID data exchange. Creation of a distributed query model is gaining additional importance given the need for companies to query data across enterprise boundaries.

Considerable research is currently underway to determine ways for using Web Services to facilitate a distributed query mode such as efforts at the MIT Auto-ID Labs Network Research Special Interest Group (SIG) where an EPC Network Simulator is being developed under the leadership of Prof. John Williams. Further, EPCGlobal document repositories have been a comprehensive source of literature regarding data exchange related efforts for generating standards and specifications.

Although the business process aspect of data exchange spans many areas, we limited our research to a review of previous literature in specific areas like inventory visibility and shipping & receiving. Inventory plays an important role in the supply chain and it is one of the main drivers for companies' supply chain performance. Basically, inventory exists because of the mismatch between supply and demand. These discrepancies are costing retailers and others millions of dollars a year. If a company has insufficient inventories, it's in danger of losing sales. But if it has more, it is carrying unnecessary supply that is subject to damage, unsold and obsolescence. We focused our efforts on researching previous literature on impact of RFID in reducing out of stocks and executing promotional programs.

Gershwin and Kang (2005) set out to quantify the benefit that RFID could bring to reducing lost sales. They first developed models to estimate the cost of inaccurate inventory. They then identified ways in which inventory estimates can be distorted and how inaccuracy could break down key performance measures. Their findings indicated that inventory estimates can be far more costly than anticipated. Even slight errors can disrupt the automatic replenishment process and result in severe shortages.

Using a simulated supply chain experiment based on MIT's well-known "beer game," Steckel et al (2004) examine how changes in order and delivery cycles, availability of shared point-of-sale or POS information, and the pattern of customer demand affect supply chain efficiency. They found that speeding up cycle time is beneficial and that reducing the cycle time through shorter lags reduced the inventory and stock-out costs.

Currently, if the inventory falls below preset safety stock levels, work is limited to reordering goods by a fixed quantity. Chen (2004) discusses the possibility for automatic inventory tracking and reordering to take advantage of the improved visibility. He cites that RFID will enable optimal reordering amount or adjust the safety stock levels based on the change in demand patterns and seasonality. With regards to manufacturing, logistics and material handling, RFID allows instant identification of a shipping container and all of the items inside. Incoming pallets or cartons can be routed automatically for cross-docking or delivery directly to the manufacturing and customer sites. During assembly processes, items can be routed and recorded for their movements. For shipping, packers can quickly locate and aggregate all the items needed to complete an order.

Manufacturers and retailers must use the RFID data effectively in order to gain return on investment. The data should reveal transit times for each part of the supply chain, the time that products spend within the distribution center and backroom of the stores. Inventory levels visibility will offer insight into electronic proof of delivery, replenishment and the business process movement.

3 Methodology

Our research project was conducted under the auspices of the MIT Auto-ID Labs and the FMCG BAG Data Exchange Pilot Work Group consisting of leading retailers and manufacturers who were involved in implementing a pilot project for data exchange in the FMCG sector. Our research methodology included the following steps –

1. Define research question
2. Conduct literature review
3. Finalize scope of thesis effort
4. Engage with stakeholders
5. Participate in Phase 1 efforts
6. Develop survey questionnaire
7. Conduct follow up interviews
8. Analyze survey and interview data
9. Synthesize observations
10. Document findings and recommendations

The research question in our case was based on the FMCG BAG data exchange project that was already underway by the time we joined the effort. We felt that documenting the business process and technical lessons learned from the first phase of the pilot would be of great benefit to companies looking to use the lessons learnt from the pilot in their respective RFID implementations.

We conducted our literature review between November and December of 2005. We surveyed RFID trade journals, magazines, technical papers on data management and EPC global documents pertaining to the data exchange pilot.

We subsequently decided to narrow down the focus of our effort to data exchange and related issues alone. Since RFID pilots typically result in issues across the board, we felt that narrowing the scope of our thesis to one specific area – data exchange, would allow us to go in depth and document some of the detailed lessons learned from the pilot.

The key stakeholders in the project were the retailers, suppliers, EPC global and MIT Auto-ID Labs. We started engaging with each of them on a limited basis between November, 2005 and March, 2006.

Subsequently, we started participating in EPC global weekly calls and engaged in mailing lists that were used for discussing implementation issues. We also engaged in conversations with key members of the pilot group and followed data exchange related documents in the online e-room used by EPC global and the Auto-ID Labs. We also tracked intermediate plenary meetings of the work group which occurred in Houston, Minneapolis and Taipei.

Once the phase 1 efforts were nearing completion, we developed two online surveys that were designed to elicit responses from pilot participants on a variety of issues we had tracked during the pilot. This allowed us to consolidate and validate our findings and verify them with the participants. The survey was distributed to the pilot members in April, 2006.

After the survey was completed, we followed up with each of the pilot participants for a phone interview during which time we dived deeper into some of the findings from the survey as well as other observations the participants had made with regard to business process and technology issues faced during the pilot.

We synthesized all the findings and came up with logical categories of observations. We developed two sets of findings, one pertaining directly to results from the pilot and ones which were beyond the scope of the pilot, but would nevertheless be of great value to companies looking to adopt RFID.

We summarized all the findings into our respective thesis chapters as well as an executive summary. An abridged version of our thesis findings was also developed for incorporation into an EPC global 'cookbook', a help guide for companies looking to start RFID pilots.

4 Supply Chain Challenges and RFID Opportunities

In a world bereft of RFID, retailers have for long been reconciled to manually intensive processes. At the distribution center all cases are de-palletized and bar codes are read automatically. An estimated 45% of goods that flow through to the stores do not fall within case/pallet paradigm. This highlights an issue in stores having to receive mixed pallet shipments and having to verify that the products match the ship lists before they are accepted in to the backroom. Even a 1% error is significant when considering the volume of receiving transactions that occur each week, especially for high value items like over the counter drugs, cigarettes, and beauty products in the Fast Moving Consumer Group Industry. Retailers typically must make trade-off decisions between cost and accuracy. RFID can help minimize this tradeoff by automating the data collection process and matching the material flow to the information flow about the transaction. One of the first learning in the Data Exchange Pilot Work Group was that exchanging the business context (Transaction ID's such as Purchase Order) with EPC read data is where EPC data adds value to the business. For example, in a pilot store receiving operation for direct to store deliveries, pallets would be unloaded from the truck and brought into the receiving dock through the RFID portal. The RFID reader captures the EPC number of the pallet and each of cases on that pallet. The system would verify against a shipping document such as an extended ASN (Advanced Shipped Notice) or Bill of Lading. This process verifies that all the cases that should have been loaded on that pallet are indeed present, and that there are no discrepancies due to shipment errors or theft. Discrepancies could then be immediately acted upon and flagged for root-cause analysis and preventive planning.

Further, Inventory Visibility provided by RFID as cases move from the back to the front of stores can provide the information to restocking and/ or picking systems to reduce the number of stock-outs in a store, thus increasing its sales revenue. When a customer cannot find what he or she is looking for, RFID could also help store employees figure out whether the product is available in the backroom, and if so, where it is located. To give an example, a store manager may know that he or she received shipment of Brand X salad packs at 5pm. However, the next day when restocking becomes necessary, he may not know whether all the salad packs have already been stocked in the produce area. As a result, store personnel may waste time trying to locate a product that may not even be available. Here, RFID readers can be installed at the temperature controlled doorways separating the backroom from the sales floor. Then when a case of product is moved from the backroom to the sales floor, the reader captures the product movement and could send alerts to replenishment systems for appropriate action. RFID at the item level promises to give retailers the ability to track product availability on shelves in real time.

4.1 Key Advantages cited from RFID Implementations

Reduced shrinkage – Theft anywhere in the supply chain can cause 2%-3%[2] of the loss in stock. Aggregating RFID data at each stage of the supply chain would help in pinpointing where losses are occurring.

[2] Lee, Hau et al (2005) Assessing the Value of RFID Technology and EPCglobal Standards for Consumer Products Manufacturers, EPCglobal U.S, p.12

Better accuracy of inventory – RFID in electronic Proof of Delivery (EPOD) will minimize discrepancies between what a supplier invoiced and what a customer actually received.

Reduced human errors – Since RFID automates the data collection process, manual entry of inventory data is unnecessary and thus avoids errors caused by this.

Reduced labor - Labor accounts for the majority of costs at a distribution center. RFID data could reduce labor by removing the need for manual intervention and use of barcodes when loading cases or stocking pallets.

Automatic replenishment – Integrating RFID data at the item level and on the shelves could provide input to systems that manage stock levels. Hence, real time updating of products not on the shelf can improve stock management to place automatic replenishment orders.

Anti-counterfeiting – RFID can help authenticate a product and combat the sale of counterfeited goods. Advanced anti-counterfeiting technologies are widely used in expensive drugs or brand name clothing.

4.2 General Overview of RFID

Radio frequency identification (RFID) is a technology that involves readers and semiconductor tags that communicate with each other using radio frequency. It is a form of identification that is contact-less and does not require line of sight. Its main function is to identify the presence of uniquely identified items. In the supply chain context, RFID promises multiple payoffs at many levels. It offers the opportunity to track goods from order sheets to manufacturing and shipping, through distribution, into the stores' back doors and out the front. A pervasive network of readers would be placed across the supply chain. Tags are placed on pallets or items for automatic data acquisition as opposed to current barcode line-of-sight scanning methodology. While barcodes adopted in the FMCG supply chain generally identify items based on a manufacturer's part number and are not serialized, RFID identifiers as specified in the Electronic Produce Code identify items uniquely. For example, an RFID EPC could, through accessing data from enterprise systems, identify when a box of chocolates was manufactured, where it was manufactured and its expiration date. In case there is a recall, it could be traced back to the origin of the material source. In addition, tags do not require line of sight technology but rather be able to scan and read from different angles. Because of this, RFID tags have the potential to track items in real time as they move through the supply chain thus eliminating intensive labor. RFID tags also withstand harsher conditions such as dust or corrosiveness. As the EPCglobal "Generation 2" standards for RFID readers and tags go into production, the technology itself is improving. UHF frequencies used for RFID in the FMCG supply chain reflect off of metals and liquids and in some case are also absorbed. But with new tag and antenna form factors and the introduction of transponders, read rates are improving dramatically. However, there are still many issues such as tag costs, network architecture, security and privacy concerns that need to be addressed.

4.3 Case Study of a Produce Company Using RFID

This case study is based on a Grower located in Western United States and complements the Data Exchange Work Group Pilot findings addressed in this thesis. The grower wishes to remain anonymous. The Grower has been supplying over 50 SKUs of fresh vegetables to several large retailers for many years.

Before using RFID, the Grower already boasted a state-of-the-art barcode information technology system for tracking its produce in the cold chain to the retailers' distribution centers. However, barcodes are applied at the harvesting field and are not entered into the system until the produce arrives at the cooling area. For example, a harvester applies a barcode for a carton of broccoli out in the field. The truck then ships these cartons to the cooling area in the Grower's headquarters. The first point of tracking starts from the cooling receiving area where information like truck information, product ID, time stamp of arrival, are entered into the computer system. Then the carton of broccoli would go through the specific cooling process. In this case of produce like broccoli, it goes through the ice injection machine that removes heat rapidly in order to extend its shelf life. Although the Grower's current barcode method is already sophisticated, it lacks the ability to track the item from the time the harvester picks the produce to the time that the truckload arrives in the cooling area. In other words, the time that the carton stays in the harvest field waiting for the truck to arrive, the travel time of the truck, and the time that the truck waits in the cooling area for receipt are all variable and not consistent. This process could range from hours to even days. The variability would drastically affect the produce shelf life.

The Grower tested various RFID equipments in their facilities. The Grower tested tags and readers from several RFID hardware vendors. Through testing, the Grower was able to better understand the capabilities and variables within each set of equipment. Some factors include water content of the product, temperature changes, wet industrial environments, and distance from tags to readers, speed of read and write, and pallet layout etc. The testing indicated that RFID read accuracy was directly related to forklift speed. It also showed that reusable plastic containers must have an external facing side in order to be read successfully while palletized. Finally, while water content directly affects the readability for the UHF 956 MHz tags that is required by the retailer, the HF frequency (13.56 MHz) worked quite well and performed reliably. HF frequencies penetrate through water and attain 100% read rate at short distances, even with the internal configuration of the RPC on the pallet.

In terms of anticipating possible benefits with the implementation of RFID, the Grower is considering gathering data before the produce even gets to the cooler. As cases are being compiled at the field, data such as date, time, harvester, lots, and product information could be stored into the computer at the very point of harvest in the field. In addition, the pallet can also be programmed such that the cases that are loaded will be matched accordingly. This will enable reconciliation of the items at the arrival of the cooling sites. By inputting data very early in the field, the process will provide several benefits. First and foremost, it will eliminate manual counting of products at the cooler receiving site. With the barcode approach, employees have to look and define each case and input data into the computer system at the cooler. By pulling up EPC information from RFID tags, it will display all the products that are in the truckload and thus reduce labor time, cycle time and human errors. Secondly, since the pallet will spell out exactly what cases are on it, the RFID software application will sound an alarm if the pallet and cases do not match. Essentially, that means theft or misplacement will be automatically identified. Without RFID tracking, theft or misplacement could go unnoticed. In addition, because the first point of tracking is at the harvest field, it is easy to trace back produce in the case of contamination. Hence, the recall process will be less severe. Furthermore, RFID reads at the retailer store can let the Grower keep track of where their produce are at the store and trigger automatic replenishment when necessary.

Finally, when RFID sensor tags become more feasible in terms of cost and technology, the Grower may benefit from adding a temperature tracking function on the pallet. Browning (1985) showed that rapid loss of quality was observed in cooled lettuce subsequently stored at 20°C. Storage at 10°C followed by ambient display gave only 3 days of shelf life. However, storage at 2°C and refrigerated display extended shelf up to 7 days. Therefore, by incorporating the temperature tracking function, the Grower could increase the shelf life of their produce.

4.4 Simplified Supply Chain Use Case Steps from Manufacturer to Retailer with RFID

- Manufacturer places RFID tag with EPC on products to enable item tracking, history file creation, and future trading partner use.
- Manufacturer references EPCs for linking pallets for shipment building, sends bill of lading and advanced shipment notices.
- RFID systems capture and publish location data to provide visibility to supply chain trading partners.
- Retailer receives ASN containing the EPC information and posts receipt upon goods arrival automatically
- Retail stores can replenish automatically because of new visibility.

5 Supply Chain Structure of Retail & Fast Moving Consumer Group Products

In this Chapter we will give a general overview of the Retail and FMCG product companies, the supply chain strategy within these companies for functional products such as those in FMCG, and the supply chain drivers for infrastructure setup within these companies.

5.1 Overview of FMCG

FMCG (fast moving consumer goods) companies produce branded products that generally have the following characteristics: products are used at least once a month, products are used directly by the end customer, and products are sold in packaged form. The main segments of the FMCG sector are branded and packaged food and beverages, cleaning products, household items, cosmetics, over-the-counter drugs, personal care and tobacco products. Some of the key factors for the success of the FMCG industry include reducing costs, increasing sales and improving productivity. This industry is dominated by big companies that are household names such as Proctor and Gamble, Gillette, Johnson & Johnson, Kraft, Kellogg, Kimberly Clark, Nestle, Unilever and Coca-Cola. People recognize these companies' brand names because they spend billions of dollars on advertising. Branding is the key to compete with similar products and to convince consumers to be loyal patrons. There is a trend within FMCG towards consolidation as illustrated by the recent example of Gillette being acquired by Proctor & Gamble. A key industry dynamic within FMCG is that as mega retail store chains gain increasing purchasing power, manufacturers must also strengthen their brand so as to retain shelf space at the retailer stores as retailers expand their private label product offerings.

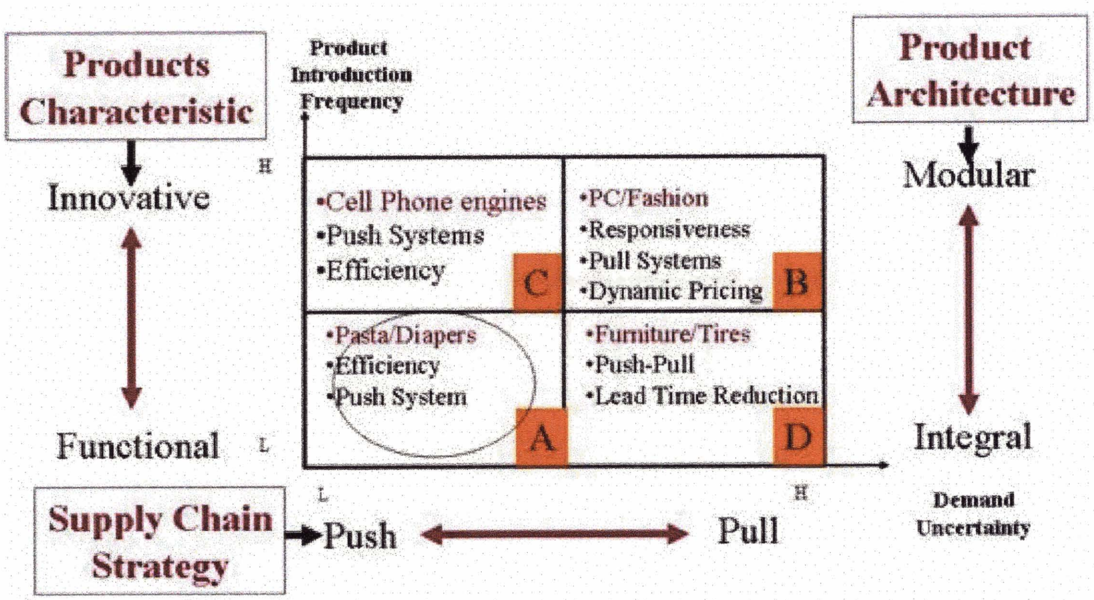
5.2 Overview of Retail

Retailing refers to the selling of products such as apparel, footwear, food, books / videos, home furnishings, toys etc to individual consumers through retail outlets. The majority of FMCG manufacturers sell their products through these retail stores. The retail landscape has evolved in the past couple decades. In the past, retail was dominated by small local mom-and-pop stores whereas now, mass merchandisers such as Target and Wal-Mart have become leading players in the industry. Bigger retailers have better economies of scale than their competitors for the same products. Hence, they drive the prices low and still achieve high profitability while smaller firms are forced to leave the market.

5.3 Supply Chain Strategy

Fisher (1997) suggests that the success of supply chains depend almost entirely on the ability of the parent companies to adopt a framework that will create an effective supply chain strategy. Further, determining whether the product is functional or innovative is the prerequisite to the creation of strategy. He defines functional product to be staples that people buy in grocery and retail outlets. These are price sensitive products which have predictable demand and do not change much over time. FMCG products would fall into this definition. Through a case study of Campbell Soup, he demonstrated that with functional products, the big increase comes from operational efficiencies. By sharing data with the retailers, Campbell was able to cut down the lead time and continuously replenish the shelf. Retailers reduced their carrying inventory and earned more profits. Products come and go quickly in the FMCG industry. Industry experts have agreed that on-shelf availability at the retail store is ranked as the number one concern for large retailers in achieving operational efficiencies. The following figure shows that FMCG belongs to the Product Type A – functional products in which success of the whole supply chain depends on efficiency and a push system for continuous replenishment to ensure that products have high turn over and availability.

Figure 1 Strategic Fit of FMCG



Source: Modified from D. Simchi-Levi Presentation Slides, Professor of Massachusetts Institute of Technology

5.4 Supply Chain Structure and Key Drivers

A supply chain in the Fast Moving Consume Goods industry starts from the point at which the customer walks into a retail store to buy some goods. She will look for the product at the shelves and then make purchase transactions. To satisfy this demand, manufacturers produce the goods and sell them to the retailers ensuring that what the customers want to buy is available when required. Yet at the same time, they are careful about producing too much or too little.

The manufacturing plants receive raw material from a variety of suppliers who may in turn have been supplied by other suppliers. The finished goods then are transported to regional warehouses and/ or distributors. Next, the goods are moved to the retailers' field distribution center closer to the retail stores. Subsequently, the goods are moved to the retail stores. After that, the employees stock these goods onto the shelves for customers to pick up. Finally, the customer walks out the door with what she needs while transferring the funds to the retail store. The retailer then provides the point-of-sales data back to the warehouse, distributor, and manufacturer who in turn replenish the stocks in a timely manner. The FMCG supply chain involves flow of information, product and funds constantly.

In between these stages, there are four drivers that regulate the supply chain: inventory, transportation, facilities and information. Let us consider Wal-Mart's supply chain structure. The competitive strategy for Wal-Mart is to provide a everyday low price and a wide variety of consumption goods. This strategy requires an efficient supply chain while maintaining a good level of customer service level or responsiveness.

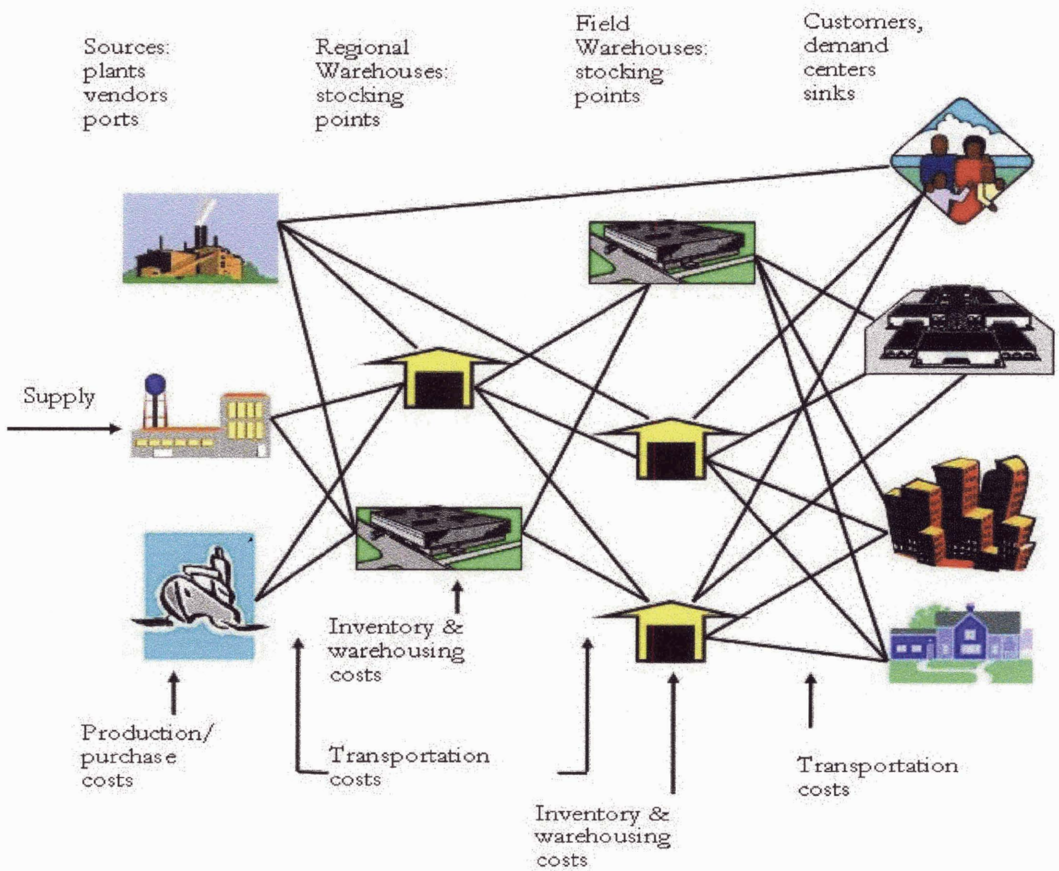
Inventory – Wal-Mart keeps inventory at a low level so as to keep costs low. Wal-Mart's distribution center operates a cross-docking system in which inventory is not stocked in a warehouse, but rather is shipped to stores from the manufacturer. Whenever possible, products are not stored at either stores or warehouses to minimize inventory holding cost. Wal-Mart favors efficiency over responsiveness with respect to inventory.

Transportation – Wal-Mart owns its fleet of trucks in order to offset the reduced responsiveness from not keeping inventory. The increased transportation cost is justified because it allows Wal-Mart to ship inventories to stores and increase responsiveness.

Facilities - Wal-Mart uses central Distribution Centers (DCs) serving its network of stores to keep the number of facilities low and efficiency high. The shipments make short stops at DCs where the goods are transferred to trucks making deliveries to stores.

Information – Wal-Mart uses information heavily to improve responsiveness and decrease inventory. It feeds demand information to suppliers and manufacturers so that manufacturers manage the production better in order to produce just the right things at the right quantity at the right time.

Figure 2 Supply Chain Structure



Source: D. Simchi-Levi Presentation Slides, Professor of Massachusetts Institute of Technology

6 EPCglobal FMCG Data Exchange Pilot

In this Chapter we will provide an overview of a FMCG Data Exchange pilot including the motivation, participant profile, criteria for success, data exchange work group and planning details. We will then dive into the Data Exchange business and technical process flow, pilot results and learning.

6.1 Pilot Overview

An FMCG supply chain may involve several partners: manufacturers, retailers, distributors, 3rd party logistics providers etc. Previous studies have shown that most of the benefits derived from implementing RFID will go to the retailer. However, manufacturers and suppliers can also achieve return on investment when data is used to their advantage. In fact, the motivation for this pilot was to demonstrate how a common scheme of data exchange can add value to business processes where timely, accurate data is essential. Example of such processes are Shipping and Receiving, Track and Trace, Inventory Visibility, Promotion Management and so on. The pilot effort was held in conjunction with the Auto-ID Labs, the EPC Global Business Action Group and the Software Action Group. The Data Exchange Work Group was responsible for formulating the technical specifications with the participating companies and set the precedent for proofing out a set of standard interfaces and business processes for RFID data exchange. The pilot effort has been underway for more than a year now as of May, 2006.

The objective of the first pilot phase is to validate the FMCG EPC related data requirements and their use in EPC business process. It's goal is to demonstrate how RFID data can be shared between supply chain partners at a very basic level. The key benefit of exchanging data in a standardized format is that business transaction events can be mapped according to a vocabulary that is understood by all parties.

The EPCglobal FMCG Data Exchange Pilot is the first RFID pilot where retailers have agreed to exchange data with suppliers using a common format. An experimental phase was conducted with two retailers who pushed their information to the suppliers when they received and processed the tagged products. The objective of the first pilot is to test standard interfaces for data exchange as well as standard elements and business vocabularies. In Phase 1 of the pilot, retailers push read EPC data to suppliers using the Electronic Product Code Information Service (EPCIS) XML schema sent via an AS2 EDI point to point communication. The commitment of these parties to participate and share their learnings is crucial to the broader adoption of RFID. The participating companies include major FMCG players such as Wal-Mart, Target, Gillette, Johnson & Johnson, Kimberly Clark, Kraft and Proctor and Gamble.

6.1.1 Pilot Participants

Wal-Mart

Wal-Mart is the world's number one retailer, with more than 6000 stores, including 1,200 discount stores, 2,000 combination and grocery stores (Wal-Mart Supercenters), and 565 warehouse stores (Sam's Club). Of Wal-Mart's 61,000 suppliers in the United States, 20% contributed 80% of its $285 billion in annual revenue in 2005. Providing on-shelf availability of a product is a critical success factor for Wal-Mart.

Target

Following in the gigantic footsteps of Wal-Mart, Target, the fourth largest retailer in the United States, announced RFID mandates in February 2004. Target operates 1,313 Target and SuperTarget stores in 47 states. It has 22 distribution centers, 3 import warehouses, and it buys products from 82 countries. The company has carved out a niche by offering more upscale, fashion-forward merchandise than rivals. It's revenue for 2005 is close to $47 billion. Target has distinguished itself by employing a strategy that relies on exclusive private-label offerings from big name designers. Increasing online business has also been a focus for this company. Not only is Target committed to using RFID tags to improve its supply chain, it is also looking at using the technology on goods it imports from overseas. Its goal is to develop an automatic identification and data-collection system that integrates with other networks to secure cargo in the supply chain and reduce theft. RFID will provide real-time visibility across international shippers.

Gillette/ Proctor & Gamble

In 2005 Proctor & Gamble announced its acquisition of shaving brand Gillette in a deal worth $57 billion, helping P&G become the largest household goods company in the world. Both companies have ambitious RFID initiatives. While P&G is focused on speed and inventory turns with RFID, Gillette is more concerned with shrink and theft. P&G anticipates the marriage of the two giants to result in increased bargaining power for the merged entity. Together, the companies produce 31 billion items per year. Individually, P&G accounts for 17% of sales for Wal-Mart and Gillette accounts for

13%[3]. When combined, this amounts to a substantial 30% of sales for Wal-Mart. In 2005 P&G's revenue came close to $57 billion.

Johnson & Johnson

Johnson & Johnson (J&J) is one of the world's largest, diversified health care product manufacturers. It has more than 200 operating companies in 54 countries around the world and sells products in more than 175 countries. Its revenue was close to $51 billion in 2005. The company participated in an Industry Work Group with Accenture and other pharmaceutical companies to explore the application of EPC and RFID and technologies in three areas: enhancing the safety and security of the pharmaceutical supply chain; improving the process of pharmaceutical returns management; and increasing the efficiency of distribution operations. Johnson & Johnson is also considering the use of RFID and EPC technologies to mitigate the risk of counterfeit drugs making it to market.

Kimberly Clark

Kimberly Clark makes facial and bathroom tissues, paper towels, and other household items. It is best known for its consumer products in more than 150 countries. The firm has been expanding into medical products since 1997 and is now a leading US maker of disposable medical goods. For years, Wal-Mart has represented more than 10% of Kimberly Clark's sales. Its revenue for 2005 was close to $16 billion. In September 2005, Kimberly Clark's RFID lab had been awarded the first Global Performance Test Center Association Accreditation Marks by EPCglobal Inc. This is one of only two facilities in North America to receive the recognition. The accreditation signifies that

[3] "Proctor & Gamble, Gillette Merger Could Challenge Wal-Mart RFID Adoption," Jan 31, 2005 ExtremeTech.com

Kimberly Clark is in a leadership position in the adoption and implementation of RFID technology. It also certifies that their lab capabilities including RFID tags, readers, printers, and applicators used in the facility have been rigorously tested against EPCglobal standards.

Kraft

Kraft Foods Inc. was spun off by Phillip Morris in 2001 and is the number one U.S. food company. Kraft Foods' major brands include Kraft, Maxwell House, Oscar Mayer, Post, Nabisco, Philadelphia, and Jacobs. Its Revenue for 2005 was slightly over $34 billion. Kraft is a strong supporter for collaborating with customers and suppliers to share data and enable supply chain efficiencies. Kraft has been involved with the development of RFID technologies since the earliest days of the Auto-ID Center at MIT. It is also committed to continued success through collaborative retail events, post-event analysis of major promotions and sharing of best practices for promotional planning.

6.1.2 Criteria for Success

The criteria for measuring success of the first pilot included validation of data requirements and vocabulary standards compliance, implementation of the EPCIS XML schema for data exchange, ability to interpret and apply this new found inventory visibility to business processes and overall learning.

6.1.3 Data Exchange Work Group

The application of RFID technology introduces tremendous amount of data in to the supply chain. There is a need to continually define business processes and requirements for software and hardware applications which will then provide the components of the network necessary to realize the full benefits of RFID technology. Keeping this in mind, a Data Exchange Work Group was created to provide a support structure for participating companies to collaborate on developing standards and protocols. Work group members are essentially end users who are domain experts with shipping and receiving processes, operations and data exchange protocols related to such processes, including experienced EDI users. The working group conducts its information exchange through conference calls, emails, eRoom[4] information sharing, and breakout sessions at the Business Action Group meetings.

At the FMCG BAG Data Exchange Workgroup face to face meetings, two principal areas were identified as areas of opportunities: Inventory Visibility and Ship & Receive.

- Inventory Visibility: Business scenarios related to Inventory Visibility were defined. The group defined use case scenarios for replenishment, production planning, promotion, shelf replenishment, redeployment, returns, recall, new product sales performance.
- Ship/Receive: Processes outlining shipping and receiving use cases were defined. A large number of exceptions for shipping and receiving such as Damaged Goods, Incorrectly-delivered Goods, Unauthorized Shipment, Audit Process, Less than 100% reads were also defined.

[4] eRoom is a platform of electronic documentation for the EPCglobal workgroup

6.1.4 Pilot Planning

Below is a list of key steps that participating companies went through to design and execute the RFID pilot. These guidelines have been presented below verbatim from the EPCglobal Pilot Cookbook reference.

1. Identify the outcomes and contributing variables from the Use Cases. For example, take the case of increasing Sales via improved Promotion OOS and Retail Compliance. If more than one Use Case is to be tested, perform steps 2-6 listed below for each. There is advantage in testing more than one at a time in terms of getting maximum leverage from the tagged products and infrastructure, but this should only be done if it doesn't compromise ability to get the learning for each Use Case.

2. Identify the base work processes that are involved in the Use Case. Flowchart or otherwise describe both the physical and corresponding data processes at a level of detail that is sufficient to show where EPC might be included.

3. Identify and decide which sustainable process/data changes should be made going into the pilot. These are changes that are judged to be sound enough to warrant the development cost prior to any real world testing. The changes should be judgmentally "sustainable" so one doesn't test something that's artificial.

4. Define where EPC reading should be added to the base/changed work processes to either: (a) enable the process changes; or (b) provide additional process understanding during the pilot. Note that the latter need not be at places where reading would continue even after the pilot is over.

5. Define the result measures and success criteria that will be needed and the means to obtain them, including both test and control measures with sufficient scale (products,

stores, time, etc) to provide statistically readable results. Where statistical readability isn't possible, recognize that anecdotal test differences may be no more than normal variation.

6. Identify the best test products or other objects that should be tagged in order to meet the test objectives, including products from multiple manufacturers if that's what the Use Case requires. These should be objects that can be tagged on a sustainable basis if the tags will be required by the base/changed process. If the tagging is to provide additional process understanding during the pilot (i.e. point 4b above), then it need not be sustainable. Product tagging variables to consider include the ability to test the target outcomes, SKU volume, RF friendliness, cost, possible disruptions to going business operations, and others. The "other objects" to tag could include supply chain personnel, shelf tags, or anything else that might improve the efficiency and effectiveness of the target processes, or improve our understanding of those processes during the test.

7. Run the pilot and collect the data.

8. Analyze the in-process data to see if it triggers additional process/data changes or tagged object changes that weren't planned at the beginning. If it does, make the changes and repeat #7.

9. Analyze and report the result measures to see if the success criteria were achieved.

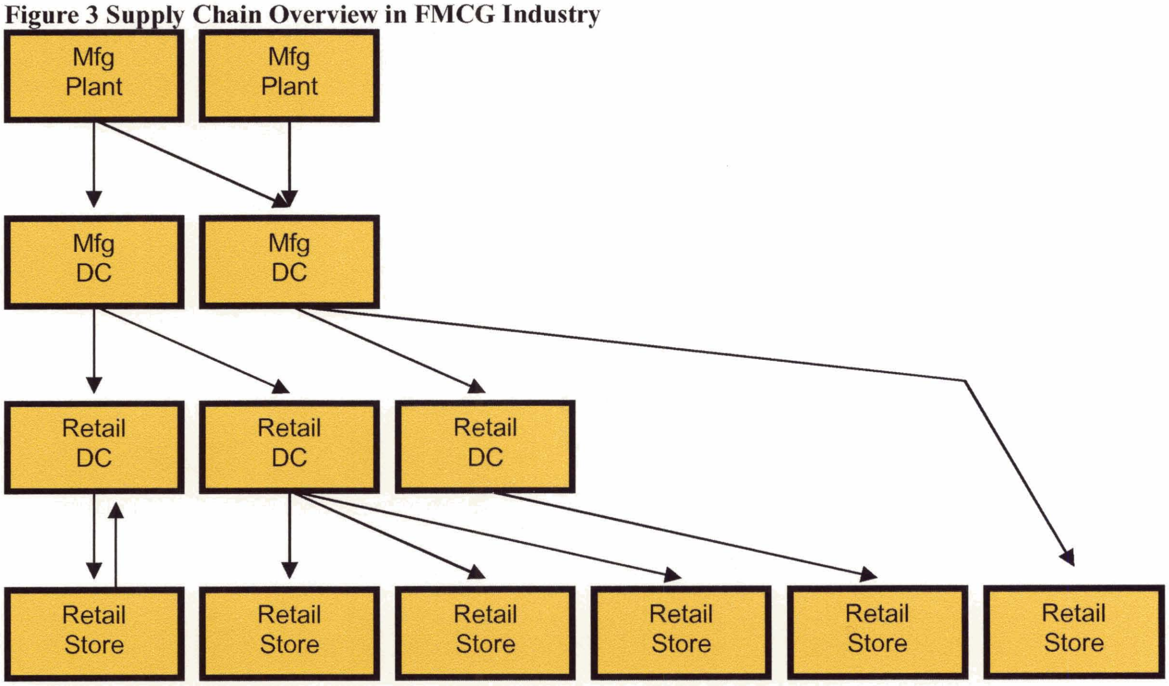
10. Review the unexpected results and focus on those findings and opportunities that were not identified up front for testing but were discovered during pilot execution. Unexpected results may come from analysis of data indicating differences in dwell time, process flow, etc. from that which is assumed. These unexpected results are learning which then would become a Use Case and begin at step 1.

This process could be executed incrementally in the sense that it could be run and measured in a small scale test (say only a few stores), prior to expansion to sufficient scale to get statistically reliable results.

6.2 Data Exchange Pilot - Business Process Flow

The FMCG supply chain partners operate a variety of business locations like manufacturer's plants, manufacturer DC, 3PL logistic centers, distributor warehouses, retail DCs and retail stores. For the simplicity of model, we will discuss only four examples of location: manufacturer plant, manufacturer DC, retail DC and retail store.

Figure 3 Supply Chain Overview in FMCG Industry



Source: Requirements for Location & Event Definition, eRoom, FMCG BAG DE Group

Within the various physical business locations operated by the FMCG supply chain partners, it is useful to define a number of standardized virtual areas or Sub-Locations to represent the logical flow of goods.

Site Sub-Location Type (SSLT) – was created to denote the type of the site sub-location. An example is the backroom or sales floor. This can be used with both a read point and a business location. There can only be a single instance of SSLT read point or business location.

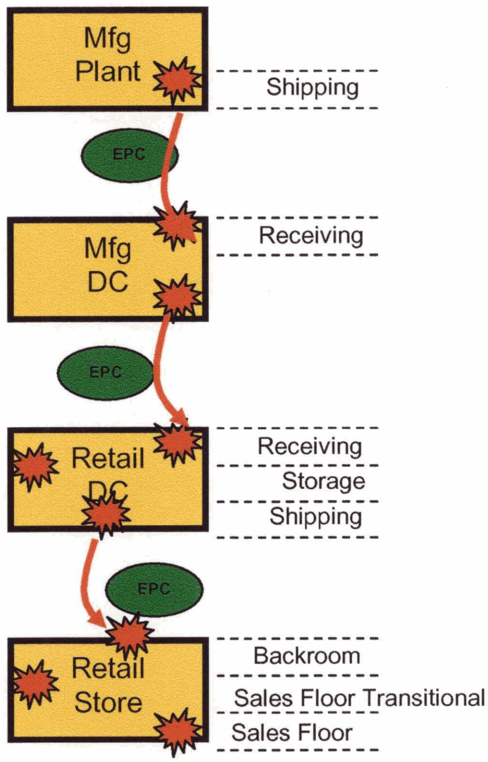
Site Sub-Location Type Attribute (SSLTA) – was created to denote the attributes of the site sub-location type. An SSLT may have 0 to multiple SSLTA's associated with it. An example could be a shelf in cold storage in the backroom. This can be used with both a read point and a business location.

Business Step – denotes steps in business processes. An example is an identifier that denotes "shipping." The business step field of an event specifies the business context of an event: what business process step was taking place that caused the event to be captured.

Disposition – was created to denote the business state of an object. An example is an identifier that denotes "available for sale." The disposition field of an event specifies the business condition of the event's objects, subsequent to the event. The disposition is assumed to hold true until another event indicates a change of disposition.

As goods move through the supply chain partner's operations sequence, a stream of supply chain data is recorded. To illustrate, consider the movement of a pallet of Huggies from the manufacturer's DC to retailer DC. This event will be shown as shipped once the inventory passes through the read point at the retailer DC. Read points are the specific place that an RFID read took place when the reader captured an event. A read point answers the question: Where was the object seen? The ownership also changes as these cases of diapers enter the backroom of the retailer's DC against a Purchase Order. The data exchange event is now generated as a result of the RFID read that consists of GTIN, Quantity and the P.O number.

Figure 4 EPC Reads Throughout Supply Chain



Example Sub-Locations
01-Shipping
02-Receiving
03-Backroom
04-Sales Floor Transitional
05-Sales Floor

Source: Modified from Requirements for Location & Event Definition, eRoom, FMCG BAG DE Group

There are two types of data generated: required data that must be accompanied by the exchange of an event, optional data that maybe provided as part of an event. The required data elements include EPC, Time, Location and Business Event. An example follows.

Event Type: Observed
EPC: xxxx
GTIN: xxxx
TIME: xxxx
Location
- -GLN (business location): 0112233001xxx
- -Sub-location: 02
- -Sub-location extension (optional)
- -Read point type (optional)

6.2.1 Data Exchange Elements

EPC: Pilot participants were required to use the unique, serialized identifiers available via RFID tags to uniquely mark cases and pallets of cases. A pallet tag in this context refers to a tag marking a collection of cases (via SSCC) and not a tag on the reusable wooden/plastic pallet asset (GRAI)

Time: Pilot participants were expected to record the time at which an observation or status change is reported in some globally consistent frame of reference. (e.g. ISO time) It was important to ensure that the sequence of events is preserved when observed by a remote system, application or database.

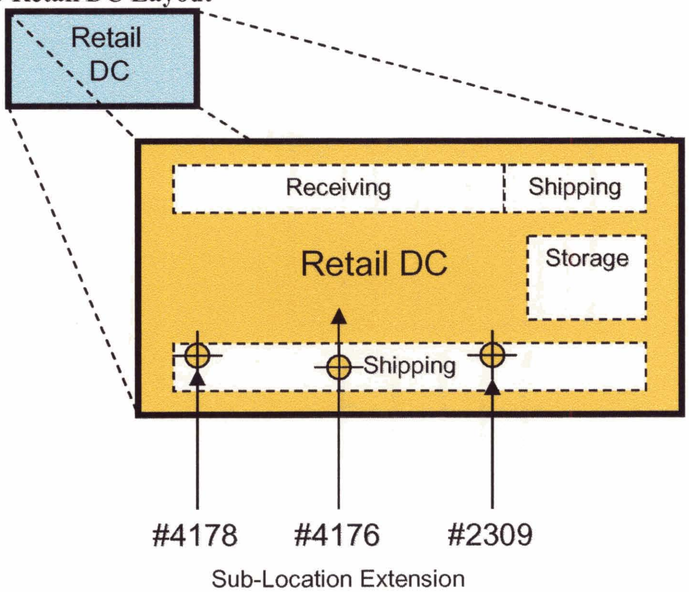
Location: The precise physical location of goods is an important and useful piece of information for many supply chain progress/status reports. However, at times a business location may replace a specific location. In addition, sometimes the specific location of the goods will not be known (e.g. in-transit, or somewhere-in-the-facility). For these reasons the pilot allowed the concepts of general locations, standardized locations and specific locations.

Business Event: Communicating useful observations about the progress of goods through the supply chain requires more than simple observations of the physical location of the goods. Pilot Participants have discussed many examples where it is impossible for a business operational application to figure out what is happening to a shipment of goods by simply observing a series of RFID tag observations. For this reason, it was proposed that partners communicate the context of the observations that are going to be exchanged. Suppliers would be aggregating supply chain Business Event data from many Retailers and similarly Retailers would ultimately be looking at data from many suppliers. If the data from each source reports similar supply chain "progress" events in a rich variety of ways, t will be difficult for the Data Exchange partner to build a complete picture of the Retailer or Supplier supply chain that originated the data.

6.2.2 Retail Store Flow

Hypothetically, once the merchandise reaches the retailer's receiving dock; raw data would be captured for the shipment. Product would be accepted and moved to the backroom or storage room. Employees would then move the inventory to the front of sales floor such as shelf, promotional display or storage depending on the specific instructions. Then the empty cartons are disposed and would indicate an EPC read at the trash compactor. At every stage, an EPC captures all required and optional data which is then integrated into the business process. Thus the increased supply chain visibility will provide a clear understanding of product flows allow for process redesign. Most of the questions related to business process can be answered by querying the EPC data.

Figure 5 Retail DC Layout



Source: Requirements for Location & Event Definition, eRoom, FMCG BAG DE Group

6.3 Data Exchange Pilot Results

In this section we present the findings of the Pilot. We will first address the issues that companies discovered and then evaluate the qualitative issues that the companies found. We will also analyze our survey data.

6.3.1 Business Process

Leading retailers and manufacturers both recognize that the fast moving consumer group industry is migrating toward a seamless trading environment. Prior to the pilot, suppliers did not have an efficient way to analyze the large amount of disparate RFID data they were getting back from retailers. As part of the pilot, two major retailers are sharing EPC data with five CPG manufacturers in a standard format. Again, the goal of the first pilot is to test out a way of synchronizing data between supply chain partners using a standard set of vocabulary and interface via an internet-based EDI called AS2. At the conclusion of this pilot, companies have found several efficiencies and improvement that sharing RFID data brings. Suppliers in particular gained insights into their products' location and status within the retailers' operation. This effort was dependent on the full and open sharing of data between partners in order to achieve additional sales and reduce supply chain cost in areas identified by Data Exchange Pilot Work Group participants.

Data Manipulation Savings

By sharing data in agreed-upon format, one CPG manufacturer was able to save 4 to 8 hours of labor time with each retail partner by automating the data download. Traditionally, retailers like Target and Wal-Mart had been providing the data in different formats. The manufacturer would have to manually log on to Wal-Mart's Retail Link and

Target's Partners Online. The supplier would then run a report on his or her product's SKU or EPC number specifying the time frame. i.e., query for all the business events for a parameter of 9am-5pm on 3/1/06 on specific store locations for the EPC. The supplier would then retrieve the report and save it as an EXCEL spreadsheet and interpret the results by looking up the retailer proprietary data table. Unfortunately, the supplier would have to do the same thing with another retail partner who uses a different data exchange vocabulary. Without standardization, the suppliers have to duplicate their efforts to translate in order to make sense of EPC reads.

Accuracy and Reliability of Data

The standardized data structure also proved to save 8 to 24 hours each time when data integrity issues came up. When data is incorrectly coded, there is an unexpected data glitch. It often takes many labor hours to investigate each problem. Consider the case where a product manager of a CPG manufacturer runs a report on a new product promotion to find out where the high profile products are. He wants to make sure that promotions have been executed and the products are available for sale in the front of the store. The CPG manufacturer could not find this information in the old system. The reason for this was that prior to RFID readers being installed between the back of the store and the front of the store, visibility onto what was in the front of the store for sale was based on marrying inventory records with picking systems data and point of sale information. This typically resulted in several mismatches.

A related data integration challenge is that bar code readers pick up Global Trade Identification Numbers (GTINs), RFID readers EPCs (which may embed the GTIN) and Point Of Sale devices register the SKU numbers. Other than incompatibility between these codes, additional data quality issues occur when an EPC number changes due to a supplier being acquired by another CPG manufacturer. It is obvious that RFID has an important role to play in addressing data glitch issues.

Supply Chain Visibility

Having clear definitions of a business vocabulary for shared business processes enables a clear understanding of product flows and as a result, allows process redesign efforts. In the case of new product promotion, a manufacturer would like to know if promotion execution requirements have been followed. If not, the product manager might want to inquire about the status with a specific retail store. For example, the manager would write a query to ask if a GTIN (barcode) representing a new product arrived at a store and if it made it to the sales floor at the appropriate time. To illustrate the role that RFID can play in querying for this information, couple of example queries is presented. The query to check whether a store has the promotion products in the backroom is "What was the last read event for all EPC where GTIN=xxx, bizsublocationtype=backroom". Similarly, The query to check if the products has been on the sales floor of store ZZ in the last X days is "What was the last read event at location (GLN) for all EPC where GTIN=xxx,bizsublocationtype=salesfloor and event date>xx/xx/xxxx

Improved Read Percentage Calculations

Sharing EPC read data in advance of shipment between retailers and suppliers allows partners to accurately calculate tag and reader performance metrics by establishing the baseline of how many tags should have been read at each point within the supply chain. This supports efforts to improve read percentages over times.

Let us walk through a typical scenario. Since RFID readers are installed at the receiving docks, at the backroom, at the entrance to the retail floor and near the trash compactors, goods shipped to the stores with RFID tags are read and recorded at each of these points. When the cases arrive in a store receiving area, the retailer records the EPC information and subsequently reads the tags again before the cases are brought out to the sales floor. For simplicity, let us assume the pallet only consists of 10 cases of goods of same SKU. At the receiving point, all 10 cases are recorded. Suppose only 9 cases are read between the backroom and the retail store front, we can assume that 1 case is still at the backroom for replenishment later. Eventually, 9 empty cases should also be read at the trash compactor, representing the goods that have been shelved. Suppliers can immediately reconcile any read percentage difference. Logically, the cases that are shown to have left the backroom to the store front should equal to the cases read at the trash compactor unless the empty boxes have been misplaced.

Improved Timeliness of the Data

The use of EPC standard vocabulary in the pilot resulted in frequent and automatic exchange of data and gave suppliers updated information on the movement and location of their goods. Furthermore, the retailers saw an opportunity to use the information about what is coming onto the sales floor with sales data from the existing Point-of-Sales (not RFID) system for better replenishment practices. The retailer would subtract the number of cases of a particular item that are sold to customers from the number of cases brought out the sales floor. Referring to the scenario above, if the retailer sold 8 cases but had previously brought out 9 cases; it would imply that there would be only 1 case of goods left on the shelf. This could trigger an automatic replenishment action. With this EPC data, the system will show that the items will soon be depleted from the shelves and automatically generates a list of items that need to be picked from the backroom in order to replenish the shelves. Furthermore, since there was only 1 case still left in the backroom, the system would flag the procurement system to order more from the manufacturer.

In a similar fashion, FMCG manufacturers use the improved visibility as well to make decisions for each different product using business rules and objectives.

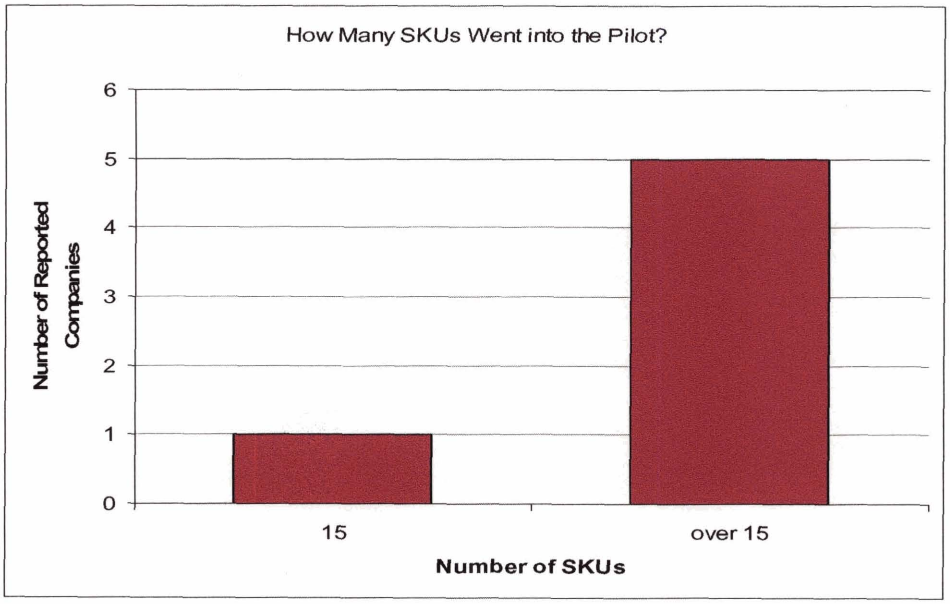
New Customer Setup

The pilot has also shown that both manufacturers and retailers benefit from a reduced cost for initial setup for data communication. Conventionally, initial setup for partner specific EDI gateway communication of RFID data cost anywhere from $5,000 to $10,000 per partnership between supplies and retailers. Having a standardized data structure enabled new retailers to join the data sharing network without significant upfront cost since it eliminates the need for translation of partner specific business vocabularies. The pilot represents a major advance toward the goal of using EPC data for supply chain visibility.

6.3.2 Survey Results

A total of 7 surveys were sent out for the participating companies of the pilot. For the business process survey we received 6 responses. We also interviewed with 3 companies to get more insights to supplement the survey. Five out of six companies said that they operated over 15 SKUs for the purpose of this pilot.

Figure 6 Number of SKUs in Pilot



Pilot Size for Promotional / New Product Launch

Of all the SKUs in the pilot, three companies reported that new product launch and promotions made up less than 10% while the rest of the companies each had different percentages. Please see below for distribution.

Figure 7 Percent of SKUs of New Product Launch and Promotions

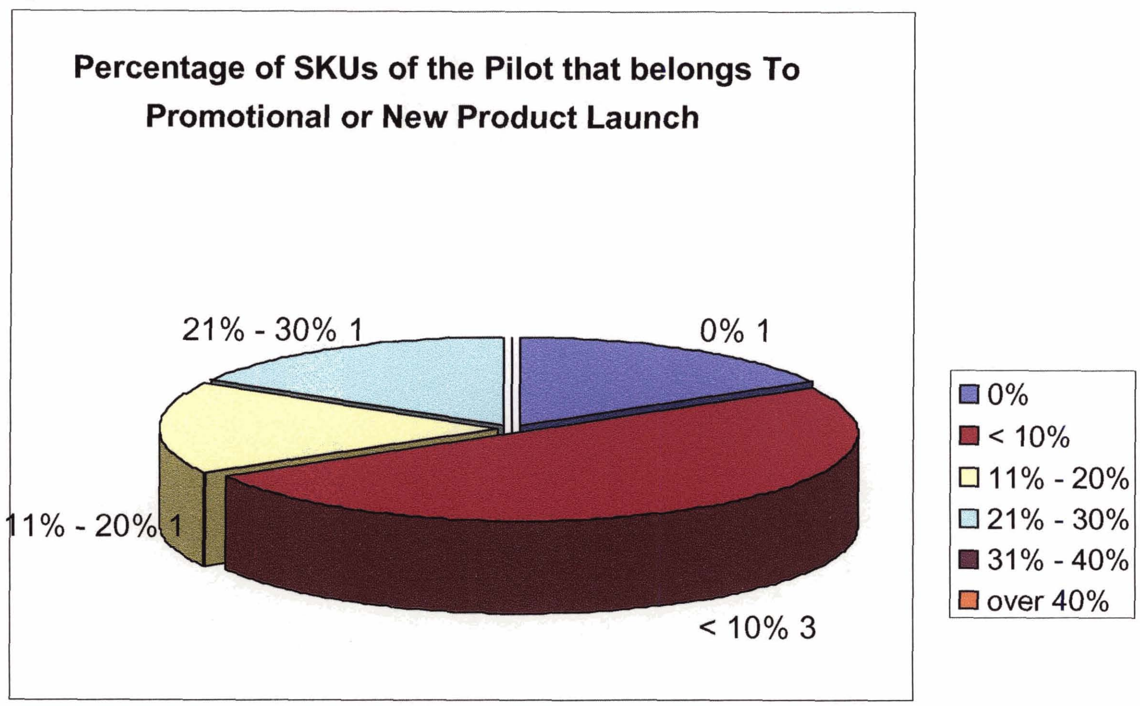
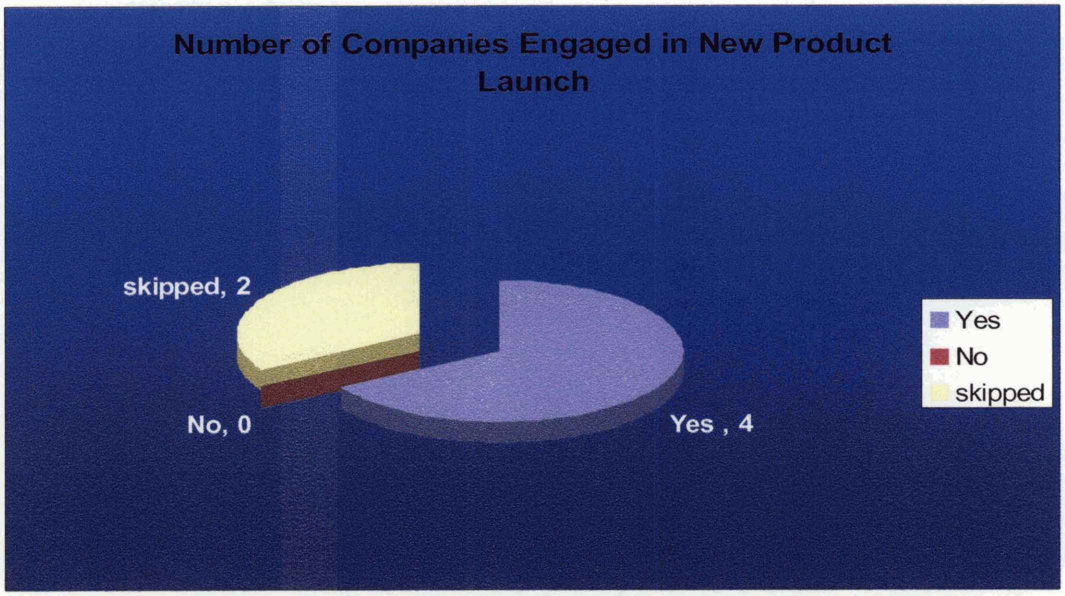


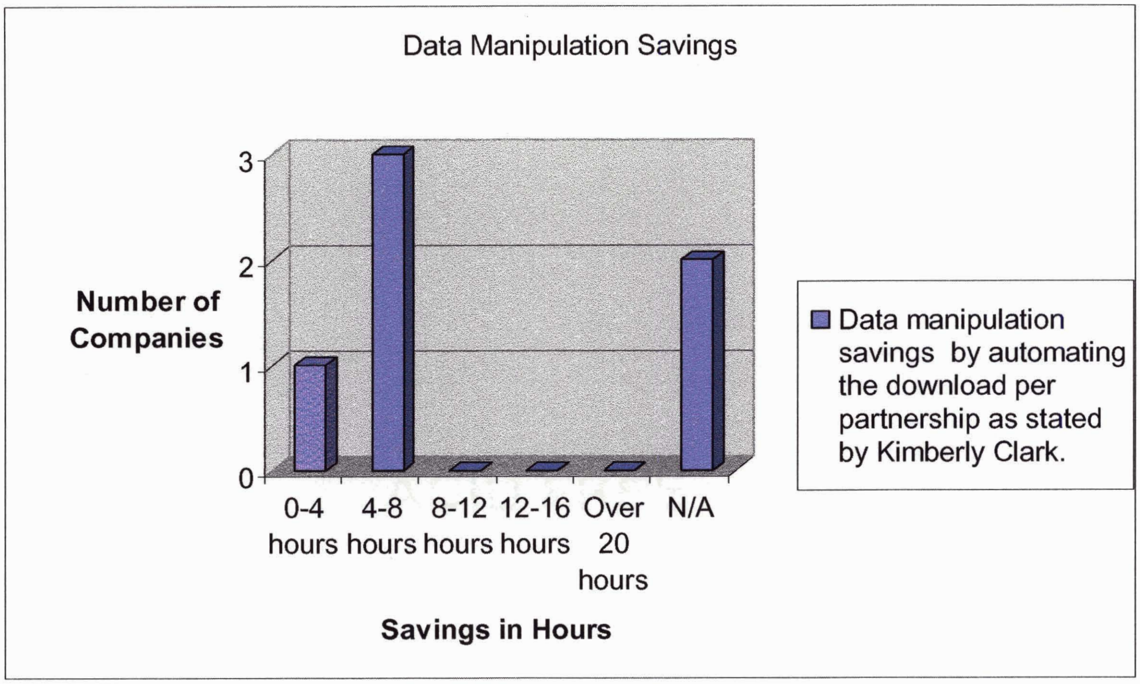
Figure 8 Companies Engaging in New Product Launch



Pilot Results for Data Manipulation Savings

Before automated RFID data exchange, the manual process for inventory reporting would involve logging in and exporting EPC read event data. The revised process involves an automated data dump of EPCIS XML data to file. Prior to standard vocabularies, it was necessary to translate retailer's data as mentioned in the beginning of this chapter in the Business Process description section. With standard vocabularies, everyone is on same page. The chart below shows the data for companies that obtained time savings from data manipulation. While the two retailers entered N/A, the CPG manufacturers have indicated that they were able to achieve significant hours of savings from reduced data manipulation.

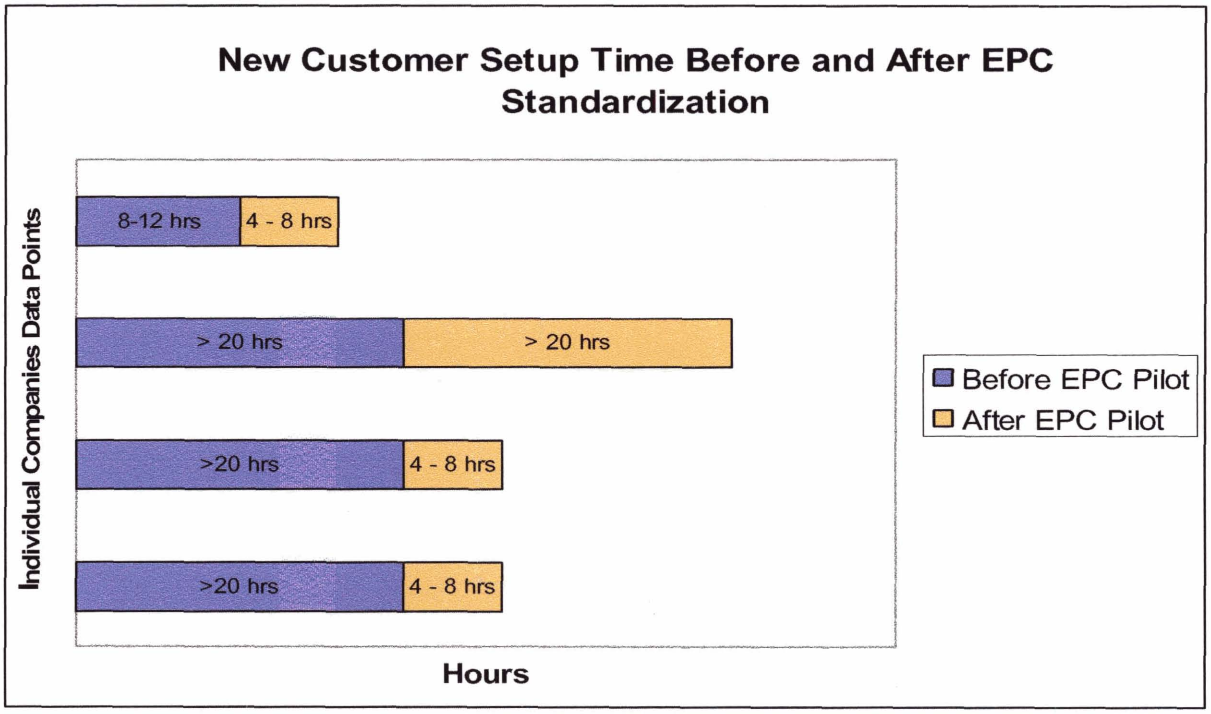
Figure 9 Data Manipulation Savings



Pilot Results for New Customer Data Setup Process

As mentioned in previous section on new customer setup, both manufacturers and retailers benefit from a reduced cost for initial setup for new partners. Having a standardized data structure enables CPG companies to add new retailers to their network in less time. Please see next figure for the hours that it took before and after EPC vocabulary synchronization based on the pilot results.

Figure 10 New Customer Setup Savings

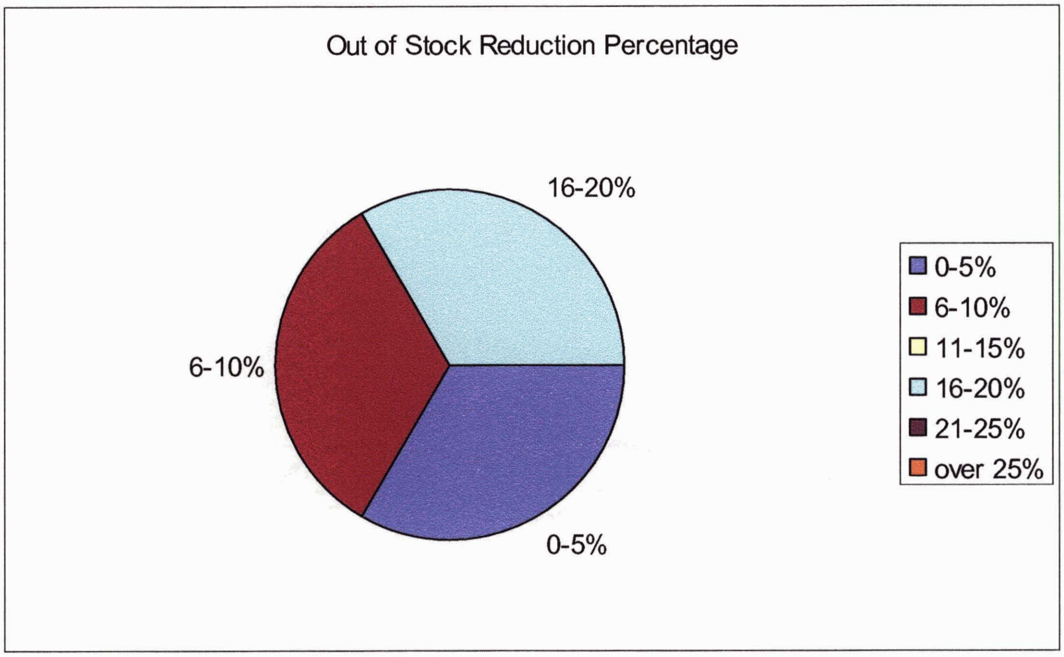


<u>Pilot Results for Anticipated Out-of-Stock Improvement</u>

Many studies have shown that RFID can reduce Out of Stocks (OOS). In particular, the University of Arkansas did a study for Wal-Mart in which it was demonstrated that RFID brought 16% reduction of OOS. The 29 week study compared and analyzed out-of-stock merchandise at 12 pilot stores equipped with RFID technology and 12 control stores without the technology. The objective was to put the stores side by side and compare performance using baseline data and EPC data. The results in that study also showed that out-of-stock items with RFID tags were replenished three times faster than comparable items using standard bar code technology. RFID enabled the retailer to reduce lead times in the whole supply chain while increasing on-shelf availability. In our survey, we asked our respondents what they anticipated in terms of improvement in OOS.

Three companies answered with varying degrees of anticipated reduction. Please see following figure for the distribution.

Figure 11 Out of Stocks

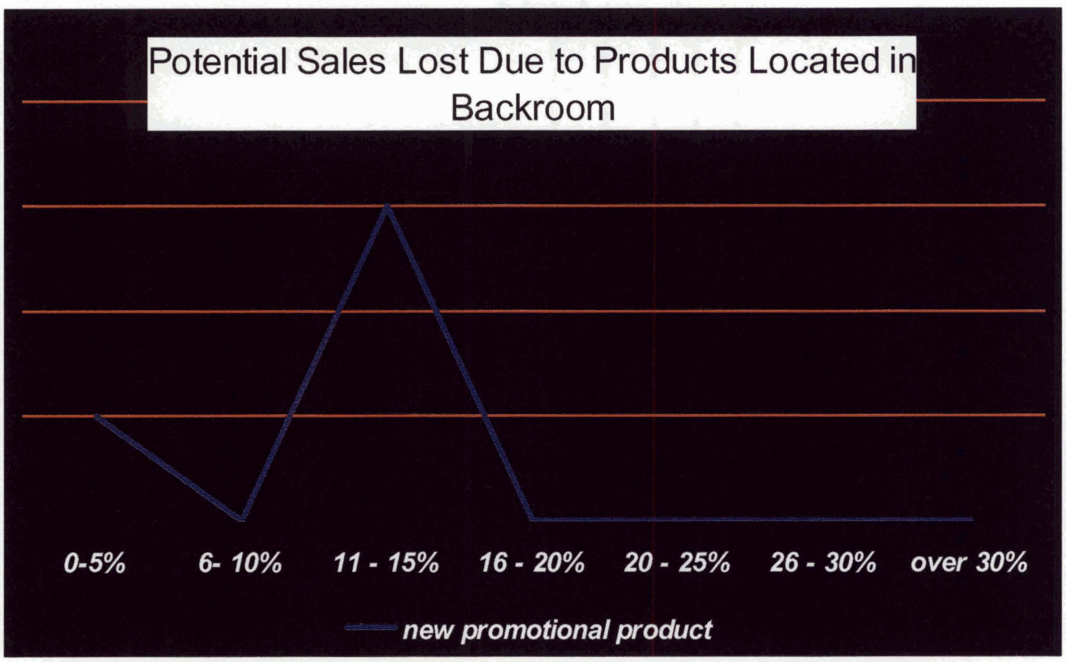


New Product Launch – Potential Savings

Gillette conducted a study to demonstrate promotional and new product launch benefits in 2005 with a strategic retail partner. The objective was to test the advantages of using RFID to track promotion execution and compliance. According to Gillette, typically 15-40% of stores are not compliant with promotion execution plans. Both the Braun CruZer and Venus Disposable razor displays were shipped to stores during the period of this pilot. For the Venus products, late execution resulted in 19% less sell through during the in-store advertising period. EPC reads allowed alerts to be issued to store employees so that displays could be "fast tracked" to sales floor. As a result, the products were in stock at all times and eliminated idle inventory. More importantly, incremental sales were recorded for the stores with timely execution. Meanwhile, the Braun CruZer Pilot was tested during Father's Day promotions. Stores that had CruZer on display for the full promotional period generated 61% greater sales. The reason is that EPC reads enabled accurate tracking of when displays moved to sales floor. When using RFID tags with high value items such as razors, one is able to see incremental sales, greater customer satisfaction, decreased labor costs and better marketing investment.

Our survey data shows that potential sales lost due to new promotional product being located in the back of the store centers around 11-15% of revenue. If we use this percentage as a multiplier, it implies a substantial amount of money lost for both retailers and consumer packaged goods companies when introducing a new product launch.

Figure 12 Potential Sales Lost Due to Products in Backroom



<u>Read Percentages from Receiving to Trash Compactor Locations</u>

The following table shows the actual read percentages as goods moved from the retailer's receiving docks to the backroom to the sales floor. The table also shows read percentages as the cartons were disposed, which is often where the highest read rates occur for cases since there are no longer products to interfere with the RF signal. This data confirms the fact that read rates are still not ideal. In fact, a majority of the companies that responded to the survey indicated that they had less than 60% read rate at initial receiving. The trend is shifting towards higher read rates as RFID infrastructure moves to Gen II technology, as well as to better shielded areas, such as at the door to the sales floor. It is also important to note that many of the product packages that were tagged as a part of this pilot were not re-designed for optimal RFID performance.

Figure 13 Read Percentages at Retailer's Staging

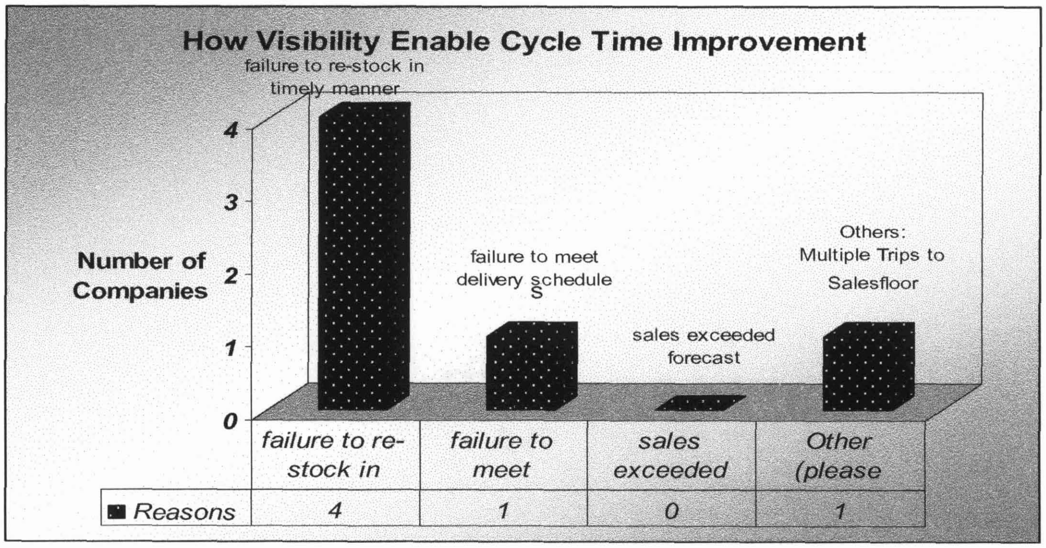
	Target		
Receiving	less than 60%	less than 60%	less than 60%
Backroom	71% - 80%	less than 60%	61% - 70%
Sales Floor	less than 60%	less than 60%	less than 60%
Trash Compactor	71% - 80%	less than 60%	less than 60%

	Wal-Mart		
Receiving	less than 60%	less than 60%	90% - 100%
Backroom	71% - 80%	less than 60%	90% - 100%
Sales Floor	81% - 90%	61% - 70%	81% - 90%
Trash Compactor	81% - 90%	less than 60%	less than 60%

RFID Impact on Cycle Time Performance

In looking at issues of cycle time performance, the visibility from RFID data helps to identify issues of cycle time. Cycle time here refers to the total time required to complete a process such as from placing the order to preparing and fulfilling the order; from when the goods are transported from the manufacturer to the retailer's distribution center and to the backroom of the stores and to the shelves. A majority of companies surveyed cited that RFID visibility could provide improvement in restocking in a timely manner by reducing the cycle time. Items with RFID tags can be replenished quicker and also meet delivery schedules. This is particularly important in promotion execution. The visibility also lets the employees of the retail stores avoid multiple trips to the sales floor to check whether certain products indeed need to be stocked. Wal-Mart, for example, plans to make use of RFID enabled handheld devices to assist in finding product locations in the backroom and locate products from the reserves. This facilitates fast cycling of products to the sales floor.

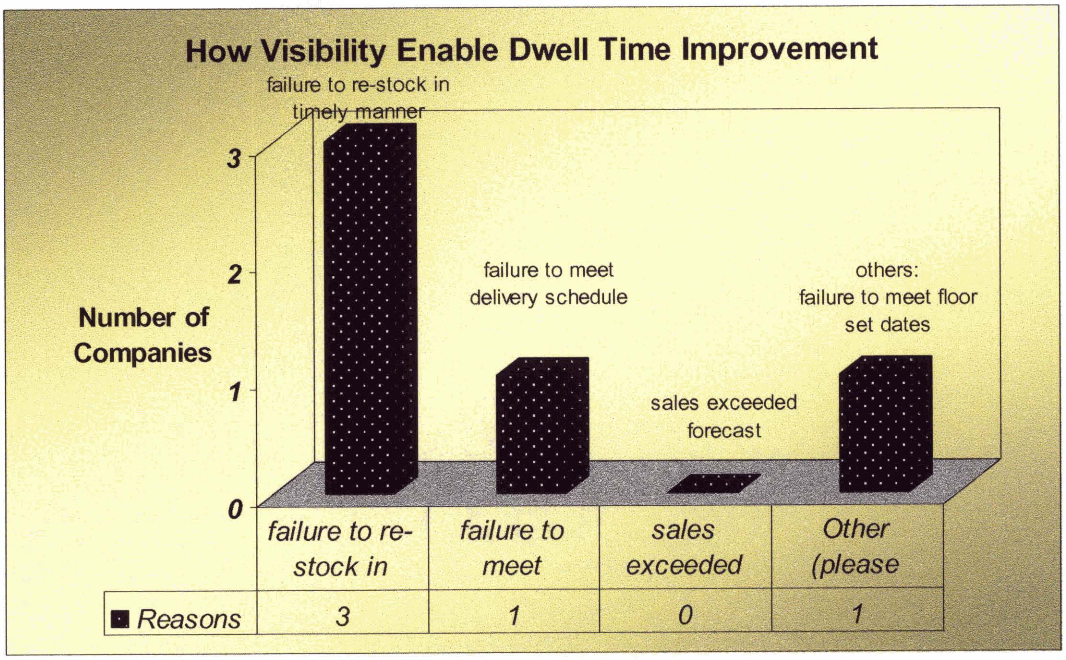
Figure 14 Cycle Time Improvement



RFID Impact on Dwell Time Performance

Here we distinguish dwell time from cycle time in that dwell time is the length of the time goods remain at a specific stage waiting for the next step. To cite an example, one would like to determine how long he cartons of ice-cream have been sitting at the dock before it was put into the appropriate freezer storage within the backroom. Package goods that are temperature sensitive are considerably more vulnerable to dwell time performance because the products are predisposed to quick spoilage. It is important to note that the pilot was designed to proof out data exchange parameters and dwell time performance was beyond the scope of this initial phase. Nonetheless this is a promising area for optimization of business processes using RFID.

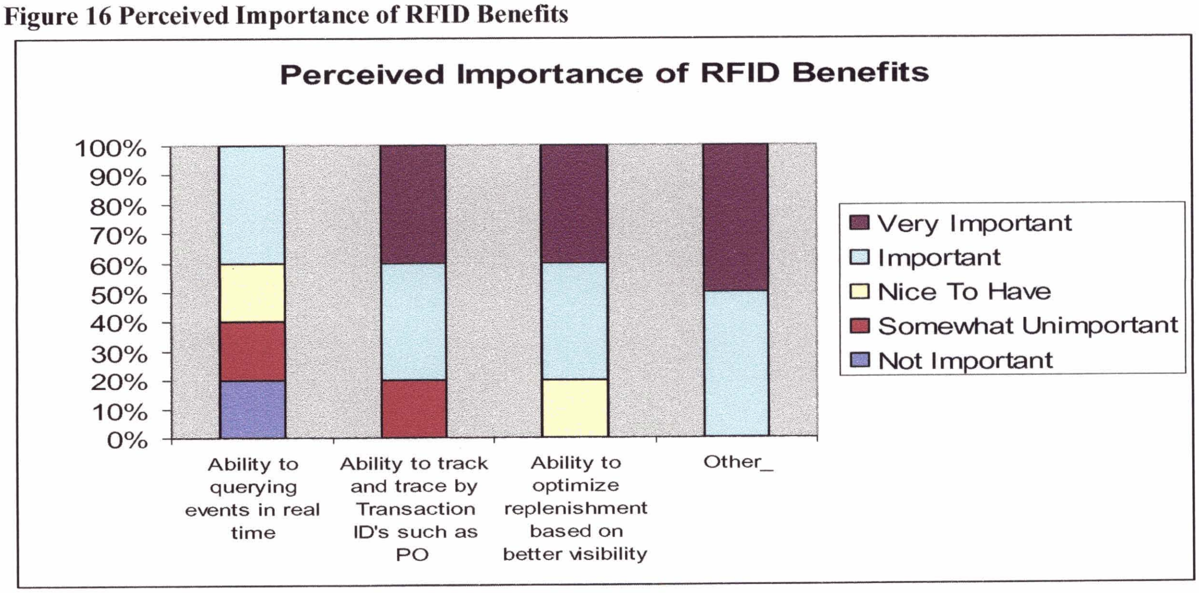
Figure 15 Dwell Time Improvement



Perceived Importance of RFID Benefits

The next figure shows the extent to which companies were interested in the ability to track and trace by Transaction IDs, the ability to query events in real time and the ability to optimize replenishment based on better visibility.

Figure 16 Perceived Importance of RFID Benefits



6.3.3 Table Summary

The following table presents a concise summary of technical issues that came up during the pilot and their status in terms of being addressed through the EPCglobal standards process.

Description	Technical Learning	Comments
Inventory Visibility	A requester can use a query to ask for quantity events. Example - "show me all retail stores where quantity for a product in the backroom is less than X." This would help trigger automatic reordering.	Requirement for use of appropriate data model and query capability; EPC-IS WG proposes use of UNDER query mechanism to identify reads in specific bizlocation.
Transaction ID's This field is composed of Bill of Lading, purchase order, etc.	By adding the transaction field, we exchange what order the transaction is part of. Hence, we see the business context for EPC read data such as staging or receiving.	Transaction ID field has been added to the EPC-IS schema by the Software Action Group EPC-IS Work Group.
Vocabulary Validation	The set of vocabulary can be modified by attributes, business processes and disposition.	FMCG business vocabulary to being reviewed by GSMP/GS1 for the inclusion in the global data dictionary
Data Validation	In Wal-Mart's Retail Link, analysis of EPC reads should allow logical deduction of inventory count by location. Example – trash compactor reads should equal to items accessible to customer or sold	Currently, Target's Partners On-Line business processes have changed making apple to apple comparisons to prior inventory visibility reports difficult.
Data Normalization	Transform inbound URN[5] (Uniform Resource Name)	URN format for EPC #'s is part of the EPC-IS version 1 LCWD specification;
Preparation of EPC Data for Feeding into Warehouse Management System	check digit logic requirement. Tag Data Standards issues around Translating embedded GTIN from EPC number subsidiary elements which must then be reconstituted to	specific issues related to various commercial data management partner like SAP, Provia. Note requirement for data translation/mapping

[5] URN - Uniform Resource Name is a name that uniquely identifies a Web service. It is location independent names for internet resources.

	look up product information in GDSN[6]	middleware.
Location Definition	Pilot participants are still learning about the differences between GLN[7] (Global Location Identifier) as virtual location vs. Read points	The initial pilot led to recommendation to minimize site sublocations. This will help with understanding of GLN
Product Profile Dependencies	An issue was raised when there are changes in the product profile; details such as Bill of Materials were not included. When that happens, retailers do not know what they miss because they were not told. In an example of a new product launch, instructions need to be stated clearly in the data preferably with enough details so that the promotional display will be placed properly.	The resolution is to establish a procedure to track changes in product profiles so as to ensure receive data on said items.
Procedure Automation	Manufacturers learned that a lack of fall-back procedures jeopardized the objective to guarantee consistent reporting.	Manufacturers are challenged to reconcile process to portal data so that consistency is shown. For example, companies should ensure equal reads, diff value mapping to portal reads-thereby establishing credibility.

[6] GDSN stands for Global Data Synchronization Network, a network of interoperable data pools and a Global Registry, the GS1 Global Registry, for communicating master data between supply chain partners

[7] GLN or Global Location Number is unique 13-digit number to identify a physical location and is part of EPC

7 Promotional Execution and RFID Monitoring

In this Chapter we will examine new product launch and the importance of timely promotional execution. We will touch upon the current methods of tracking promotion effectiveness. Because trade promotion is often a substantial percentage of the manufacturer's spending, it is crucial for manufacturers to know how effectively their money is being spent.

We will then introduce the idea of using RFID in conjunction with new product launch in the fast moving consumer goods industry. We will examine questions such as how RFID would help, how the improved visibility would enable manufacturers to track whether their new products are actually available for sale at the specified time.

The idea behind using RFID for promotional execution involves placing readers at strategic positions at the retail store in order to trace where the products are located. The products might be at the backroom of the stores or they might be at receiving or might not even be shipped. Even if they are available at the front of the stores, they might actually not be in the end-caps.

To get a sense of the impact RFID can have in promotional execution, we present a hypothetical example. Let us assume there are 100 retail stores, out of which 90 received the shipment of a high value product like razors on time. Further assume that 5 of the stores did not place the razor at the shop floor. Another 3 put it on the sales floor but did not put it on end cap. In terms of profitability, 100 – 10 – 5 – 3 =82 stores executed right; 18 stores did not. If the expected revenue for each store is \$300k, then we are losing \$300k x 18 = \$5.4 million of revenue for this scenario alone. We can see the profound effect when we extend this model to the entire FMCG industry.

7.1 Promotions and New Product Launch

Here we will explore the type of sales promotion and why new product launch is such a promising application of RFID for FMCG companies. In addition, we will talk about why it is important to track promotion effectiveness and present some of the current practices.

7.1.1 Sales Promotion

Sales Promotion consists of short term incentives to encourage purchases or sales of a product or service. It offers reasons to buy now. An example of Sales Promotion is the end-the-aisle display (also known as end-cap) in the local supermarket. This display tempts impulse buyers with a wall of Potato Chips cartons. To cite another example, a retailer store receives say a 10% discount on selected razors if it agrees to advertise them in local newspapers for a specific time frame.

Within Sales Promotion, there are a variety of promotion tools designed to stimulate stronger market response. It includes

Consumer Promotion – samples, coupons, rebates, prices-off, premiums, contests, and others.

Sales Force Promotion - designed to motivate the sales force and make sales force selling efforts more effective; includes bonuses, contests, and sales rallies.

Trade Promotion - another form of sales promotion designed to gain reseller support and to improve reseller selling efforts including discounts, allowances, free goods, merchandise allowances, cooperative advertising, push money and dealer sales contests.

In this paper we will focus on **Trade Promotion** because this is where most sales-promotion dollars are directed. Trade Promotion is used to persuade retailers or wholesalers to carry a brand, give it shelf space, promote it in advertising, and push it to consumers. Shelf space is so scarce these days that manufacturers often have to offer price-offs, allowances, buy-back guarantees, or free goods to retailers and wholesalers to get on the shelf and stay on it. Manufacturers use several trade-promotion tools. They may offer a straight discount off the list price on each case purchased during a stated period of time. This is also known as price-offs. This often motivates retailers to buy in bulk quantities or to introduce a new item. Manufacturers may offer an allowance in return for the retailer's agreement to feature the manufacturer's products in some way. An advertising allowance compensates retailers for advertising the product. A display allowance compensates them for using special displays. These displays and demonstrations are called Point-of-Purchase (POP) promotions which take place at the point of purchase or sale. An example is a five foot high cardboard display of animated figures next to Oreo Cookies packs. Sometimes, the products are placed at the end of an aisle and are coined as "End Caps". Manufacturers may also offer free goods, which are extra cases of merchandise, to middlemen who buy a certain quantity or who feature a certain flavor or size. They may offer push money – cash or gift to retailers or their sales force to "push" the manufacturer's goods.

AMR researcher Garf (2004) stated that retailers will spend an estimated $113B in 2004 on the development and execution of promotions and related marketing plans. Further, consumer packaged-goods companies would fund more than 90% of what retailers would spend on advertising, marketing and promotion[8]. Today in many consumer packaged-goods (CPG) manufacturers, trade promotion accounts for 10% - 30% of their annual revenue[9].

7.1.2 New Product Launch

Given the rapid changes in consumer tastes, technology and increasing product choices, companies today must introduce a steady stream of new products and services to keep up with competition. New-product development refers to the development of original products, product improvements, product modifications, and new brands through the manufacturer's own R&D efforts. When the new product is first launched, the introduction stage starts. During this stage, profits are low because of low sales and high distribution and promotion expenses. Heavy promotion spending is necessary because the firm needs to attract consumers and get them to try it. This is particularly true in the fast moving consumer goods industry. This strategy promises to bring the fastest market penetration and the largest market share as exemplified by Gillette's Fusion razor blades. Data from Information Resources Inc, a consumer researcher, show that the two Fusion Products, Fusion and a battery-powered vibrating version called Fusion Power, together accounted for 55% of new razor purchases four weeks after it went on sale. Grant (2006) emphasized that the company had spent millions of dollars on the launch. It claims that 70% of retailers who stock Gillette have committed to in-store displays for three to six months.

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[8] Bonasera (2002) New Advertising, Marketing, and Promotion Management Processes and Application Will Give Retailers More Control in Creating Demand and Higher Returns

[9] Preslan et al (2005) Promotion Effectiveness: More Important Than Ever for Consumer Products Companies

7.1.3 Promotion Effectiveness and Timely Execution

So why is it important to have timely execution? With the billions of dollars spent on promotions and new product launch, firms must measure the return on investment. They must ascertain if these promotions generating the increased sale that is expected and if the money is being well spent. Currently, however, it appears that there is still a significant gap between promotion plans and the execution of those plans in stores. According to conventional wisdom, half of all promotional expenditures are wasted[10]. The reality is that many promotional displays never make it to the sales floor. Point of Purchase Advertising International (POPAI) estimates that 50% or more of promotional displays delivered by consumer-packaged-goods companies to retailers are never installed on retail floors.

Traditionally, promotion programs focused on how to promote, the time and target of the incentive, length of the promotion and the budget constraints. However, the success of any promotional program depends on product availability to the consumer during the promotion period – not just in the store but also on the selling floor. The challenge rests with the communication of activities to the stores employees who must perform the duties according to the plan. Are there right products at the right stores? Is the shipment complete and in right quantity? Are the right fixtures supplied? Is the display and signage properly placed? Is it time to put them on the shelves for sale? Is everything executed according to plan? If not, what are the contingency plans to fix? These are all questions that must be answered in order to ensure that the promotional spending is well spent. If any of these factors deviate from plan, then the effectiveness of

[10] Lee, Hau et al (2005) Assessing the Value of RFID Technology and EPCglobal Standards for Consumer Products Manufacturers

the promotion is greatly distorted, reducing the return on investment, and may even lead to permanent lost sales. In addition to measuring return on investment on promotion activities, leading companies are shifting toward creating demand through execution of promotions. As seen in the new product launch of Gillette's Fusion products, the manufacturer is able to shape the demand of their five blade razors.

7.1.4 Current Methods for Tracking Promotion Effectiveness

How do firms monitor their promotion performance now? Currently, in the complex environment of various marketing channels and promotional campaigns, few companies are able to accurately track the overall effectiveness of their promotional spending. Many companies fail to evaluate their sales-promotion programs and many others evaluate them only superficially using random on-site retail compliance sampling data compiled in EXCEL spreadsheets. There are many reasons for this starting with the lack of a cost-effective way to determine whether the materials are even displayed in the targeted stores. Kotler and Armstrong (1996) suggested that the simplest method is to compare sales before, during, and after a promotion. Suppose a company has a 6% market share before the promotion, jumps to 10% during the promotion, falls to 5% right after, and rises to 7% later on. The long run rise to 7% could mean that the company gained some new users. However, if the brand's share had returned to the old level, then the promotion would have changed only the timing of demand rather than the total demand.

Consumer products companies today invest in several categories of tools to support promotion effectiveness. However, there is no single platform that addresses all of the necessary components for promotion effectiveness. The conventional way of tracking the execution and effectiveness of promotional displays and signage involves human monitoring of the displays in the retail stores. This is done by using auditors hired by either the consumer-packaged goods company or the retailer[11]. This way of tracking for in-store compliance is expensive and auditors typically report only on a sample of stores. Another example is a software platform, a field-service trade funds management system designed to let CPG manufacturers verify that retailers are complying with trade promotions. The system gives manufacturers real-time information on the progress of a trade promotion rather than wait days and weeks after the end of promotion for statistical data on retailer compliance and product performance. The software system alerts store managers of promotional responsibilities and generates a calendar prompted task list scheduled by chain headquarters or a supplier. The following software vendors are described in AMR Research as software vendors who understand the gap between the promotional plan and shelf reality and are developing tools to address this problem.

- **Reflexis**--In addition to using Reflexis' *Task Management* application to streamline communication between home-office planning and store execution, customers such as the Home Depot use the vendor's *Risk and Audit Manager* to conduct store-walk audits. For example, store and regional managers use a portable handheld device to capture product display compliance for items put on the shelf by store associates or directly by merchants from supplier partners. To truly measure the effectiveness of a promotion, retailers must execute the desired merchandise-related tasks in a standard fashion across all stores.

[11] Wilson, M. (2006, Feb). Promotion Management, Chain Store Age

- **StorePerform**—This company has *Workbench* product that is designed to handle workflow for promotions to ensure that the appropriate store associates in each store receive the home office execution mandates related to the promotion. For example, when the home office designs a planogram shelf display for a sale, the system triggers a workflow that distributes the information to stores on the right date and assigns the tasks to the right people for execution. The outcome can then be monitored and reported back to the corporate office to ensure compliance. Its flagship customers include Sears, Lowe's, and Best Buy.
- **RW3**—Consumer product sales teams are RW3's typical targets. This vendor provides them with the information they need to enforce promotions, garner more business, and identify additional opportunities. Rather than leaving it up to the salesperson to track the corporate promotion calendar and determine a plan of action, RW3's toolset translates the information for the sales rep. When the corporate office agrees upon a promotion with a retailer, the information is applied to each store and passed down to the individual sales reps or independent brokers. The information shows how much shelf space should be dedicated to the product, dates that the signage should be put up, level of inventory required to fulfill the promotion and other key data. RW3's key customers include PepsiCo, Nestle and Sony Computer Entertainment[12].

These tools merely facilitate promotion execution and each has different drawbacks. The tools also do not provide real time accurate reports of whether the activities are executed according to plan. Radio Frequency Identification (RFID) can play an

[12] Garf, R. & Presland, L. (2004, Sep). Retailers and CP Companies Travel the Last Mile of Promotion Execution

important role here once suppliers integrate the data into the existing enterprise infrastructure. In the next section we will discuss how RFID can be used in conjunction with promotional and new product launch in the fast moving consumer goods industry.

7.2 Integration of RFID Technology with Promotional Monitoring

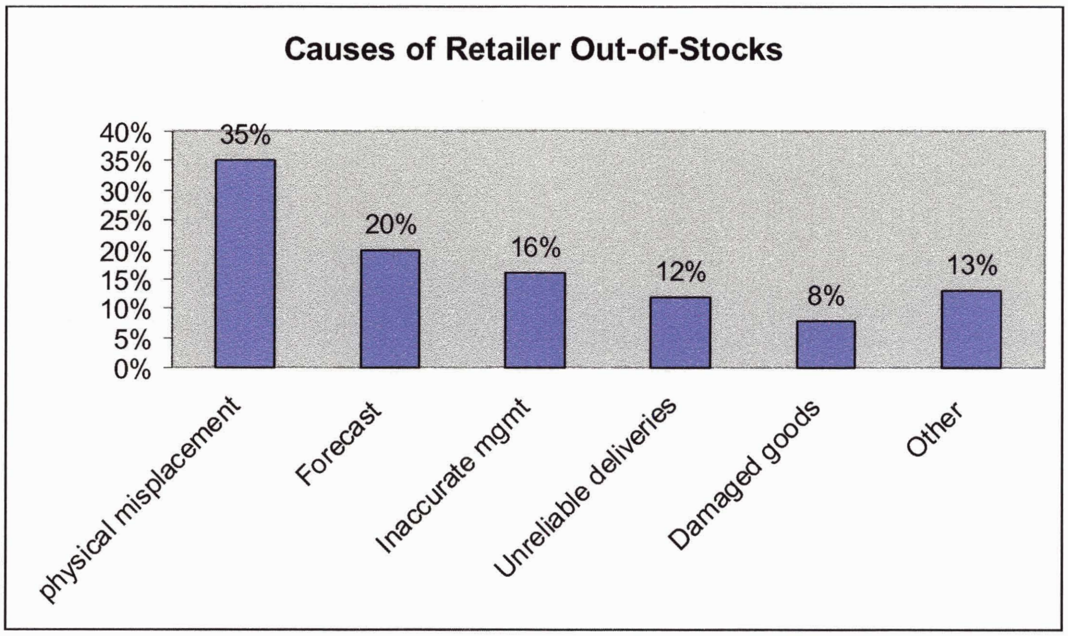
In this section we will examine the current out-of-stock situation in CPG companies and how this creates opportunities for companies to use RFID to maximize their revenue. Because the use of RFID will enable visibility throughout the supply chain from the suppliers to retailers, companies will be able to have a way of tracking promotional execution to the last 100 feet. We will illustrate with a case study for Gillette's Fusion products. As mentioned in Chapter 6, when retailers and manufacturers agree to exchange business information in standard format, both parties can easily track the promotional items and replenish in a timely fashion. The pilot has shown that when companies use agreed upon data exchange vocabulary, it is possible for supply chain partners to ask for events such as how many SKUs are received by each retailer for all their stores. They can further questions such as - Are they shipped on time? How many SKUs are out in the sales floor? How many are still sitting in the backroom but should have been shelved? Are the displays or end caps located appropriately? Most of these questions can be answered by querying the relational databases.

7.2.1 Out of Stock Problem

When customer demands cannot be met due to out of stock, the customers either purchase a close substitute or they leave the store without buying anything. They may come back a few days later to purchase again or they may switch brands entirely. The perceived quality of service is likely to damage the brand image. In any case, the scope of out-of-stock (OOS) problem is huge. Billions of dollars are lost annually by retailers and manufacturers because the right product is not available for sale on the shelf or display at the right time. For example, when a fan watches a Bud Light commercial during the Super Bowl, he decides to drop by the closest supermarket during half time hoping to quench his thirst. However, when he gets to the store, there is no Bud Light available in the aisle. He becomes irritated because what he wanted badly is out-of-stock and he wants to quickly run back home to the second half of the game. So, he buys competitor Coors Light instead. In many cases, the Bud Light inventory is not really out-of-stock but is located at the cold-room in the back-store. But because it was not displayed properly at the refrigeration section, the stock out event led to customer ill-will. If this situation happens another time, the impact can lead to permanent brand damage. Imagine this scenario happening at thousands of retail stores with millions of different kinds of products. The out of stock problem during promotions leads to massive customer disappointment and negative reputation and low customer service levels. The use of RFID in this scenario will help solve this problem by alerting store employees to replenish the beer on the shelves before they are even empty.

There are several reasons for out-of-stock occurrence. In a recent survey study done by Lee et al (2005), it is stated that the most common reason of OOS in the retail store is physical misplacement. This happens when the items are actually available in store but are not on the designated shelves or display where customers can find them easily. The products are maybe misplaced in other shelves or they may still be in the backroom waiting for store employee to deliver them to the right storefront location. The number two reason for out-of-stock is demand forecasts. The retailer or manufacturer may under-estimate the forecasts for the promotional products. In an ideal world, when a product is in the promotion phase, a customer should be able to pick up that item with ease. The instant that the item leaves the shelf, another would immediately take its place and so on and so forth. Inventory would be lean and products would not be manufactured or distributed for which there is no demand. While this can never happen in reality, the use of RFID can help suppliers and retailers move closer to this perfect vision.

Figure 17 Out-of-Stock Reasons



Source: EPCglobal "Assessing the Value of RFID Technology and EPCglobal Standards for Consumer Products Manufacturers." (2005)

The manufacturers in Lee et al's study indicated that, on average, more than 30% of their products are sold through promotions. It is not surprising for companies to spend billions of dollars each year on promotions. They also showed that the impact of an out-of-stock situation during a promotion is much more detrimental when compared to the same situation during regular sales. They inferred from the survey that promotion related out-of-stocks cause manufacturers an average 10% of lost revenue per year compared to less than 1% during regular periods. Because many consumers report organizing their shopping trips based in part on advertised promotions, these levels of out-of-stocks have even more profound ramifications. This suggests that a better way of monitoring inventory will enable both retailers and manufactures to reduce the magnitude of out of stocks.

7.2.2 Gillette's Fusion New Product Launch Case

RFID tags have the potential to be tracked in real time as they move through the supply chain. Tags are placed on pallets and cases when inventory move from different stages - from order sheet to manufacturer and shipping, through distribution, into the stores' back doors and out the front door and at each stage in between. In a recent example involving Gillette' Fusion razor products, Gillette placed RFID smart labels on all cases and pallets of the razors shipped to 400 RFID enabled retail locations of its two customers involved in the pilot[13]. Gillette also placed active RFID tags on Fusion promotional displays it sent to the retailers. The advantages of RFID are seen as soon as data shows the goods arriving at the retailers' distribution centers to the point where its outer packs ended at the box-crusher machines. The reads at the box crusher infer that all the contents had been placed on shelves. If the retailer's EPC feedback network showed the Fusion razors or promotional displays had reached a retail store's back room, but no read events were recorded to show that the goods were placed in the sales floor in a timely fashion, Gillette would contact the managers of these stores and request that the razors and displays be brought out. In this new product launch, RFID enabled Gillette to get the product from Gillette's distribution center to the shelves in 3 days compared to the

[13] O'Connor, M (2006, Mar). Gillette Fuses RFID With Product Launch, RFID Journal

14 days of typical for a new product launch. This is 11 days faster than its normal turn-around time. Since the products were shipped to 400 retail stores, 11 days of sales in these stores would have been missed but for the RFID enabled new product launch. While this information is not public, we could easily infer that RFID can bring a substantial increase in sales for manufacturers like Gillette.

7.2.3 Benefits of using RFID with Promotions and New Product Launch

There are many benefits that RFID can bring along for promotions and new product launch business scenarios. Below is a list of some of the pain points and how RFID can solve these problems as discussed in Underwood & Keske's (2004) use case analysis in EPCglobal business action group.

Monitoring Performance Criteria – It is important to establish the quantity of product shipped, received and made available to consumer during the promotion periods so as to benchmark business results. RFID data will show the quantity of product on the selling floor during the performance period. It can directly establish that the product is available to the distribution center in time to ship and is on the selling floor during the promotion period.

Monitoring Special Packaging – Products that are in promotion often have special packaging that temporarily replace regular packaging. It is often difficult to ensure that the special packaged product is shipped to the store and on to the selling floor in time to be synchronized with mass marketing activities. Here, RFID can help get the special pack product on to the selling floor in a timely fashion. Also, RFID data can show how much of special packaged products are left at the retail warehouse.

Monitoring Inventory to Sales – As indicated in previous studies, promotions help sell more product than is normally on the selling floor and it is difficult to ensure that sufficient product is in the store or more importantly, on the selling floor. RFID can provide instant tracking to ensure product is available for purchase. If sales performance is poor, manufacturers and retailers need to evaluate whether products are misallocated or under-forecasted.

Preventing Post Promotion Overstock – Not all products sell as expected. With accurate tracking of product placement and point of sales data, manufacturers can execute lean production strategies in order to avoid overstock. Promotions can be extended or shortened based on demand visibility.

Monitoring for Displays – Manufacturers pay retailers for display either directly or as part of the bill-back funds. Yet, it is difficult to ensure that those displays have actually taken place in every store. When more products are moved to the selling floor than can fit on the retail shelf, additional display must have been placed since it is impossible to hold the entire inventory otherwise. The RFID facilitated move of items from back room to selling floor informs the manufacturer that the required additional displays have been built.

'Disappearing' Product – When products are shipped but are not counted as sales, then the manufacturer assumes that the products did not sell and that maybe the retailer is holding overstock. RFID can enable manufacturers to see if the 'disappeared' product was ever received by the store or if the product moved out of the retailer distribution center and made to the store. It helps ascertain the legal liability.

Monitoring Collateral – POP (point-of-purchase) promotion collateral such as shelf talkers, display units, signs and banners cannot be tracked currently. If the POP moves from the backroom of the store floor and does not move back to the backroom, it can be assumed that the store is using the marketing display. Since manufacturers pay to have this collateral up and retailers have a vested stake, both retailers and manufacturers need to know whether the collateral is effective.

Benefits of Using RFID for Retailers

Recent studies by the Grocery Manufacturers Association[14] show that retail stores still average about 7.4% out-of-stock overall and close to 17% out-of-stock on promotional items. This means that on an average, 17% of the time, a consumer cannot find the promotional product he or she wants to buy because it is not on the supermarket shelf. They study also found that almost 40% of consumers would postpone their purchase or buy the product elsewhere. The current out-of-stocks situation puts RFID as a crucial technology to boost incremental revenue for retailers. One of the business processes that retailers can enable is to create automated and prioritized pick lists for store employees to use when stock is low on shelves and products are in the backroom. If none are available, the computer system could trigger a red flag for immediate replenishment from the distribution center.

Benefits of Using RFID for Manufacturers

The improved visibility into inventory that RFID brings enables suppliers to see where their promotional products are at any instant. This precise information will not only trigger continuous replenishment and enable shared, real-time electronic data on

[14] Grocery Manufacturers Association Study Executive Summary
http://www.gmabrands.com/industryaffairs/docs/execsum.pdf

production demand and inventory control; it will also allow faster time-to-market as demonstrated by Gillette's Fusion case. In the competitive consumer packaged goods environment, reducing cycle time and dwell time in a new product launch will potentially increase the opportunity for revenue growth and create customer brand loyalty. The concept of the "demand-driven supply chain" -a phrase coined by AMR Research – suggests that the ability to get information about sales data on a real time basis is necessary to figure out on a micro level what is selling best where and then tailor manufacturing appropriately. Ultimately, RFID data allow manufacturers to optimize the sales of their products and improve fill rates.

7.2.4 RFID Infrastructure Setup – The Combination of Hardware, Software and Partner Collaboration

How might retailers and manufacturers setup the infrastructure so that RFID can be used to track the promotions and new product launch? First, all partners must agree to the effort and collaboration that RFID usage requires. Hardware like readers and antennas must be installed in transitional places like backroom, storage area, sales floor and staging area. Of course, manufacturers must place RFID tags in pallets and cases in which they are shipped. The hardware system setup should make it possible to track inventory as it moves from point to point across the supply chain network. The goal is to trace goods from plant to pallet to store shelf – all in real time and without human intervention. While the hardware network is setup, manufacturers and retailers must also exchange data back and forth in a standardized format. This is where EPCglobal comes in. The main focus of the EPCglobal is to create both a world-wide standard for RFID data exchange and the use of the Internet to share data via a service called the Object

Naming Service (ONS)[15]. ONS is a service that can return a list of network accessible service endpoints that pertain to the EPC in question. ONS does not contain actual data about the EPC. It contains merely the network address of services that contain the actual data. In the case where a retailer wants to check whether there is any stock in the backroom, she can query for quantity events such as given a GTIN[16], show where quantity is less than X in the site sub-location. GTIN or Global Trade Item Number is part of the EPC and is a numeric value used to identify a trade item. With the visibility, she can decide whether she has enough products to be shelved properly. In order to get the maximum return on the RFID technology, supply chain partners must work together in terms of setting up the infrastructure for hardware, software and data information exchange. Please refer to Chapter 6 where we have discussed the FMCG data exchange pilot data exchange elements and vocabularies, pilot planning and overall learning. In particular, we have talked about the implementation details of how the pilot enabled a way of testing out the standardize data structure as demonstrated by the promotion use case queries.

[15] Definition of ONS from www.epcglobalinc.org/EPCglobal_ONS_1.0.pdf

[16] Definition of GTIN from http://www.gs1.org/

8 Technical and Organizational Issues

In this chapter, we will go into the details of technical and organizational lessons learnt from the EPCglobal Fast Moving Consumer Goods (FMCG) Data Exchange (DE) Pilot. We were privileged to have as participants in the pilot two of the largest retailers in the world and five Fortune 50 suppliers. The learning experience from the pilot has indeed been substantial. For one, these companies are arguably among the most influential in the fast moving consumer goods sector. As such, their actions and experiences from the pilot can shape industry standards and best practices to a large extent. Further, the data exchange pilot represents the very first time that an industry consortium comprising retailer and vendor stakeholders have come together to facilitate RFID data exchange. This is perhaps the first time that two of the largest retailers in the world have communicated supply chain information in a common machine readable format. The implications of this effort could pioneer the way that RFID data is exchanged within and across enterprises.

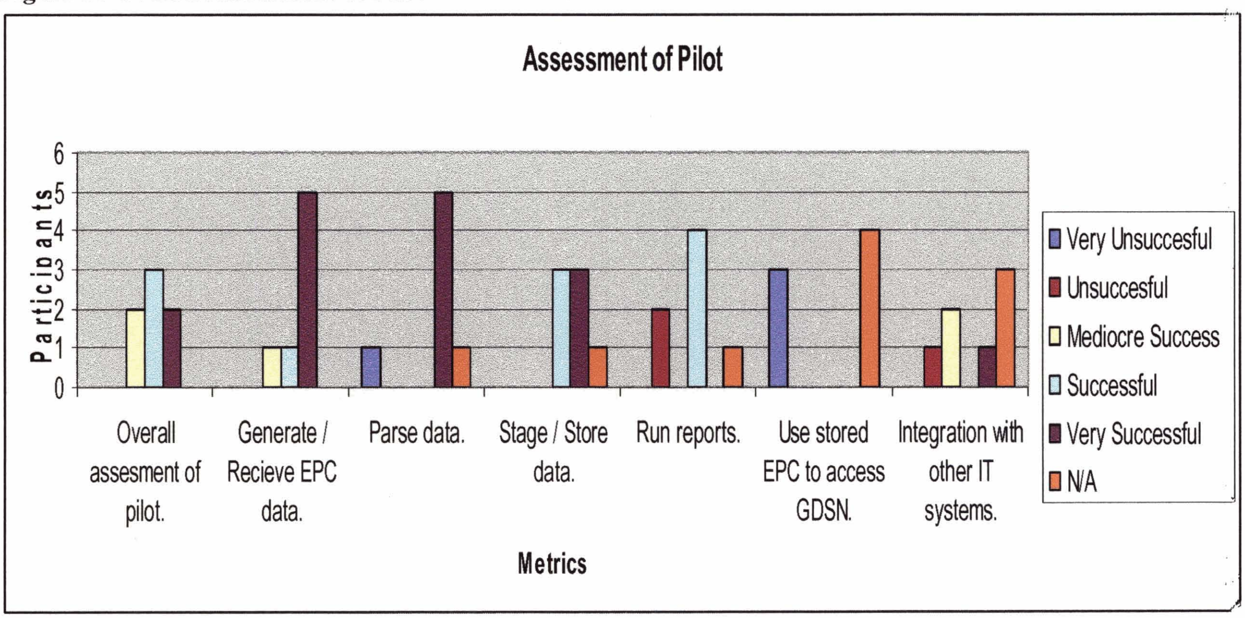
We have organized this chapter into three logical areas. In the first part, we deal with software and configuration issues. This section details the specific low level technical and configurations related issues that were observed during the pilot. Though these are by no means comprehensive, some of the lessons from this section would add substantial value to any new adopter. One of the biggest challenges involving adoption of any new system is to address setup, framework and architecture related issues. Through this section, we also hope to document some of the network architecture issues.

In the second part of this chapter, we deal with the project and change management related issues. Since the pilot project represents one of the earliest attempts to setup and staff a team to exchange RFID data, the learning in terms of project and people management and related processes could add value for new adopters looking to setup similar pilot projects.

In the final part, we document some of the areas that were outside the scope of the first phase of the data exchange pilot, but nevertheless, would be of interest to any company considering adopting RFID within its supply chain. These areas include topics like EPC-GDSN integration, Distributed Query Models and applications such as Electronic Proof of Delivery (ePOD), automatic replenishment and fulfillment. . References to these topics came up several times during the weekly pilot conference calls though they were beyond scope. As such, an understanding of the implications of some of these infrastructure issues would help a new adopter to better architect RFID IT infrastructure and rollout strategies.

Enclosed below is a summary of the overall assessment of the pilot by the participants. We received responses back from all but one of the participating companies.

Figure 18 Overall Assessment of Pilot



The results of the overall assessment of the pilot are rather intriguing. Two of the participants indicated that their pilot was a mediocre success. Both of these participants were suppliers. Given the high visibility that RFID pilots have within these companies, describing such a pilot as a mediocre success indicates how difficult the pilot process and/or business justifications must have been for this group. Our analysis of the pilot results indicate that one of these companies may be questioning expanding its pilot into a subsequent phase. However, all the other pilot participants have qualified their pilots enough of a success to start on the second phase of the FMCG Data Exchange pilot.

Most participants were successful in generating and receiving and parsing the EPC-IS schemas and storing the EPC data in a database. One participant highlighted issues in its efforts to parse the EPC-IS schema as being very problematic and these issues are documented in the section on XML parsing.

Two participants indicated that they were unsuccessful in classifying EPC read data and running meaningful reports. One of the first learnings from the pilot is that for RFID data to add value, it is not sufficient for companies to record and transmit EPC read events. Companies need to understand and interpret these events in some business context. Under these circumstances, reports play a key role in driving intelligent decision making based on the data exchange. Architectural issues with reports and queries are discussed in detail later in this chapter.

Three of the pilot participants indicated that they had not linked stored EPC numbers to their corresponding Global Trade Identification Numbers (GTINs) as would be required to access the Global Data Synchronization Network (GDSN). Though this was not officially part of the data exchange pilot, the integration of EPCglobal data with information resident in the GDSN network is considered as an important outcome from participating in an EPC data exchange pilot in FMCG industries.

As an illustration of how important it is to clean up product information, we looked at the number of SKUs for Kraft's Macaroni and Cheese Meals and what caused the build up of an extraordinary number of SKUs and the associated data glitches. To quote David Hutchings, Senior Director of Business to Business (B2B) efforts at Kraft, "The variations are due to permutations of product descriptions and product codes that cause seven and a quarter ounce Macaroni and Cheese Dinner to look like a different product in various business partners planning and transaction processing systems. Permutations can also be caused by technical restrictions ranging from truncating a 12 digit code to 6 to 8 digit variations of the official product code which in combination cause the 'over 30,000' different instances of the same product as was the case within the database of a service provider we used in the late nineties to do an early proprietary version of data sync." Clearly, as different retailers were able to record anywhere from six to twelve of the GTIN in their systems, and often used different descriptions for the same product. More specifically, if a company has not cleaned up their internal GTIN, SKU and EPC numbering schemes and product characteristics as stored in the GDSN, then it will be difficult for their partners to know what the EPC numbers they are referring to. Thus, linking the EPC network with the GDSN network will help considerably with data harmonization.

We hope that highlighting these challenges will make new adopters aware of the need to plan for integrating RFID data with product master data that is contained in the GDSN registry. The real value of RFID, as described in recent presentations by Dick

Cantwell, Vice President of RFID at Proctor and Gamble (P&G), comes from sharing EPC data that can be used across the supply chain and the integration of EPC data with Information Technology (IT) systems. We are certain that this area will be of considerable interest to new adopters. In the experience of the pilot participants, integration with legacy IT systems has been one of the biggest challenges.

8.1 Software and Configuration Management

Since the Data Exchange pilot undertaken by FMCG BAG members was one of the first attempts to setup, configure and implement a full fledged software system to support EPC data exchange, several software and configuration management issues were addressed during the pilot. Based on the graph summarizing the overall assessment of the pilot, it is clear that while companies have been extremely successful in basic metrics like generating and receiving EPC data, their results have been mixed in areas like parsing data, integration with IT systems, EPC-GDSN integration and generating reports with meaningful business process data.

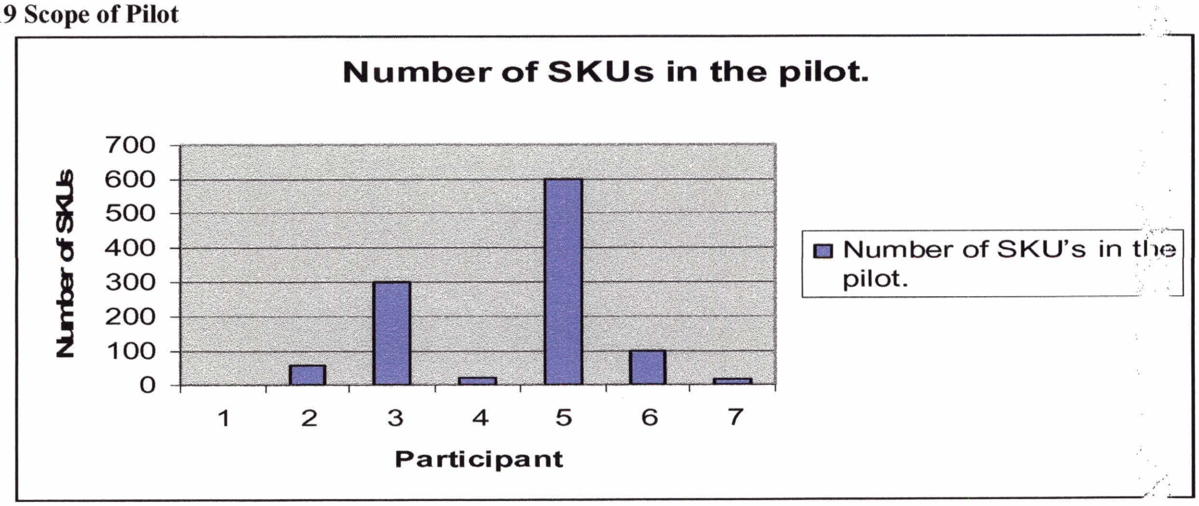
The following summary of key lessons from software and configuration management are presented in the spirit of participants wishing to save new adopters time for system setup, development and roll out. It may also help new adopters set realistic goals for their initial pilots. Details and analysis of some of the key technical issues are enclosed below. It should be noted that many of these issues are specific to the point-to-point nature of the Electronic Data Interchange (EDI) Applicability Statement 2(AS2) protocol. Concurrent with the development of the AS2 binding for Electronic Product Code Information Service (EPC-IS), the EPCglobal Software Action Group (SAG) has also been working on other bindings including web services which provide data integration/transformation capabilities that are not available in the AS2 environment. We expect XML feeds to be one of the data sources available in a future phase of the pilot.

8.1.1 AS2 Network Topology: Provisioning AS2 Circuits

Companies that elect to leverage existing EDI AS2 infrastructure for exchanging EPC data will need to analyze the pros and cons of setting up a new AS2 line versus exchanging EPC data over an existing circuit that also carries EDI inventory and financial transaction data. Since EPC data traffic is likely to grow over time with the addition of more tagged items, data volumes for a given pilot will play an important role in determining network and capacity requirements. A retailer involved with the pilot indicated that near real-time data transmission was not scalable and made a decision to switch to batch mode communication of EPC data with some business context. A supplier pilot participant indicated that they anticipate facing issues with traffic overload on their existing AS2 infrastructure at the time of moving to a production environment.

To get a sense of the data volumes involved in the pilot, several participants recommended that we start by identifying the total number of SKUs involved in the pilot.

Figure 19 Scope of Pilot



The number of SKUs processed varied widely from 16 to 600 (depending on whether the participant was a supplier or a retailer). One pilot participant reading 100 SKUs indicated that they handle approximately 6000 read records per day. Another participant estimates 2kb per read event. A participant with 16 SKUs indicated that they handle 94 reads/day/SKU (1504 read events / day). At 2kb per read, this would translate to approximately 3MB per day. Wal-Mart indicated that they had 600 SKUs in the pilot. Ron Moser from Wal-Mart's RFID strategy team had the following comment on data volume – "We are currently getting approximately 1,200,000 cases and 10M-12M reads per month".

We recommend that suppliers who adopt a point-to-point AS2 topology create a planning template and map out the data transmission requirements for their pilot by estimating the number of SKUs, estimating the number of read events from the specific retail partner and multiply this by the data transmission per read. Estimating the number of read events will involve mapping out the business processes since read events will correspond to the movement of items across readers.

Resource planning considerations for AS2 infrastructure include provisioning these circuits and involve configuration and setup. Hence, corporate level AS2 gateway support would be required. One participant indicated some issues with obtaining support from the EDI software vendor. To the extent that companies relied on legacy EDI software gateway functionality to parse XML data, they were unsuccessful. Also the attempt by the EPC-IS Security Work Group to specify an X.509 certificate exchange mechanism for AS2 proved to be ineffectual since this would have required EDI software vendors to alter their field lengths.

Some of the pros and cons of setting up a new AS2 circuit versus reconfiguring an existing line are summarized below and illustrate different approaches to planning a pilot.

- Setting up a new line
  - Assessment of requirement for new AS2 circuit is based on estimates of EPC traffic growth.
  - A new line has the benefit of not interfering with transmission of orders, invoices, Advance Ship Notices (ASNs), Point of Sale (POS) data and so on.
  - A new AS2 line often has the disadvantage of lacking robust support from operations and this is characteristic of the EDI links.
- Reuse of existing AS2 line
  - Use of an existing AS2 line is highly sensitive since it already carries purchase, inventory and invoice data for EDI.
  - There is a possible network traffic overload with an increase in volume of EPC data exchanged.
  - In the case where suppliers rerouted their EPC data to a third party for analyses, reuse of an existing line has the further challenge of separating data types for retransmission.
  - On the positive side, existing AS2 lines are likely to have well established corporate support vis-à-vis EDI (this is based on the Fortune 50 companies represented in the pilot).

8.1.2 Provisioning EDI SW Gateway

During the pilot, the main issue identified with EDI software gateway support was that early versions of XML parsers included with these software products did not support current parsing capabilities. At least one of the pilot participant indicated that they had issues with an early version of an EDI/XML gateway software product that were not resolved with the vendor. The introduction of new client software, a major issue in any large company, for XML parsing as well as middleware for XML data translation and mapping is perhaps one of the most important areas that will need careful planning, training and support.

8.1.3 Routing multiple data feeds – planning requirements

Several pilot participants rerouted RFID data to a third party for analysis. They recommend that suppliers terminate the AS2 session with the retailers and initiate a separate session. Participants noted the requirement to plan for retailer specific policies for data masking and/or encryption as a part of their planning process.

8.1.4 Transport failure backup and restoration plan

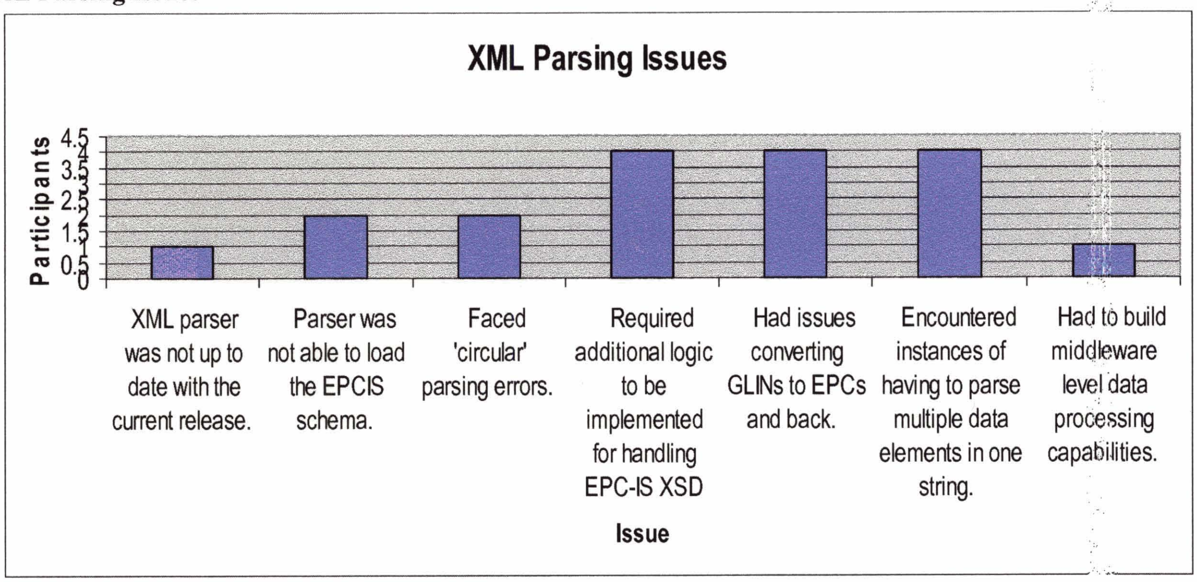
It became clear during the pilot that companies need to plan for failover in case of communications link failures. Since a key benefit of participating in an RFID pilot is the automation of EPC data reporting, it is important that a high degree of credibility is maintained. Thus, restoration procedures assume added importance in the event that the circuits are down so that the EPC data is not lost as was the case for several participants.

8.1.5 XML Parsing Issues

XML parsing of the first EPC-IS schemas turned out to be a key issue during the pilot with several participants facing similar challenges. However, most of the parsing issues were solved except for one participant who indicated that their data parsing efforts were unsuccessful.

A snapshot of the most commonly encountered issues is enclosed below –

Figure 20 XML Parsing Issues



The most common issues seemed to involve implementing additional logic for handling EPC-IS XSD and converting GTINs to EPCs and back. The issue of converting EPCs to GTINs also has implications for GDSN integration. It is worth noting that half of the pilot participants indicated that they were unsuccessful integrating EPC and GTIN. This issue of data mapping is more complex than it might appear in the context that shipping hierarchies are created from shipments that may be designated by GTINs or Serial Shipping Container Codes (SSCCs) of pallets, cases, sleeves and/or eaches as well as special promotional displays.

With regard to circular errors from parsing the EPC-IS schema, a key point to consider is the software and release level of the parser used. Many pilot participants were not using the latest products and versions of XML parsers available today. However, some of the pilot participants were able to verify that the latest versions of common parsers such as XML Spy work. During communications regarding this issue with the EPC-IS WG of the EPCglobal SAG, it was suggested that XML schema best practices and XML parsers have evolved over time and hence participants would be encouraged to use the latest release level. A big middleware vendor like IBM carries close to forty XML parser products that have accumulated over the years. One example from the pilot is the - IBM Websphere Data Interchange (WDI) on OS version 3.2. The EDI SW Gateway with an earlier version XML parsing capability did not support EPC-IS practice of using variable number of strings with variable record sizes in the XML.

Concatenation of data elements with the urn prefix was another issue that came up repeatedly with respect to parsing for storing data elements separately. For example, bizStep (urn:epcglobal:epcis:bizstep:fmcg:stocking) is one data string but contains two sub elements, the urn prefix and the business step "stocking". At least one pilot participant indicated that concatenated data created significant parsing issues which limited reporting and GDS functionality.

In some cases, multiple data elements were carried in one string. For example, bizlocation (urn:epcglobal:fmcg:ssl:0085239.00578.210.415) contains the data elements GLN (0085239.00578), the sub location type (210) and the sub location type attribute (415). In such cases, the initial recommendation was to develop special application / middleware processing to parse these attributes into separate fields.

Subsequent deliberations with the EPC-IS Software Action Group have resulted in a nomenclature where data attributes are separated by semicolons so as to facilitate parsing. This enables XML parsers to handle each data element separately rather than as one string. It also provides the flexibility to handle variable data elements that may occur many times or may not occur at all such as the sub location type attribute.

An ideal goal from a pilot project would be to have data services that meet the business data requirements but are also simple to use and implement. Schemas that require complex mapping or middleware will have slower adoption rates. Since the purpose of storing RFID data is so that it can be queried, separate namespaces are recommended for maintainability by the various business action groups. Further, at least one pilot participant indicated that their AS2 gateway client could not handle XSDs and hence, they had to reverse engineer DTDs. Though translation is always possible, there does seem to have been an issue with data formats that require data translation capabilities.

8.1.6 Communications Topology

Since RFID based systems involve large volumes of EPC data exchange, it is essential to ensure a scalable and reliable communications infrastructure for any rollout to succeed. One key decision point in preparing for a pilot is on the issue of using synchronous versus asynchronous communications mechanisms.

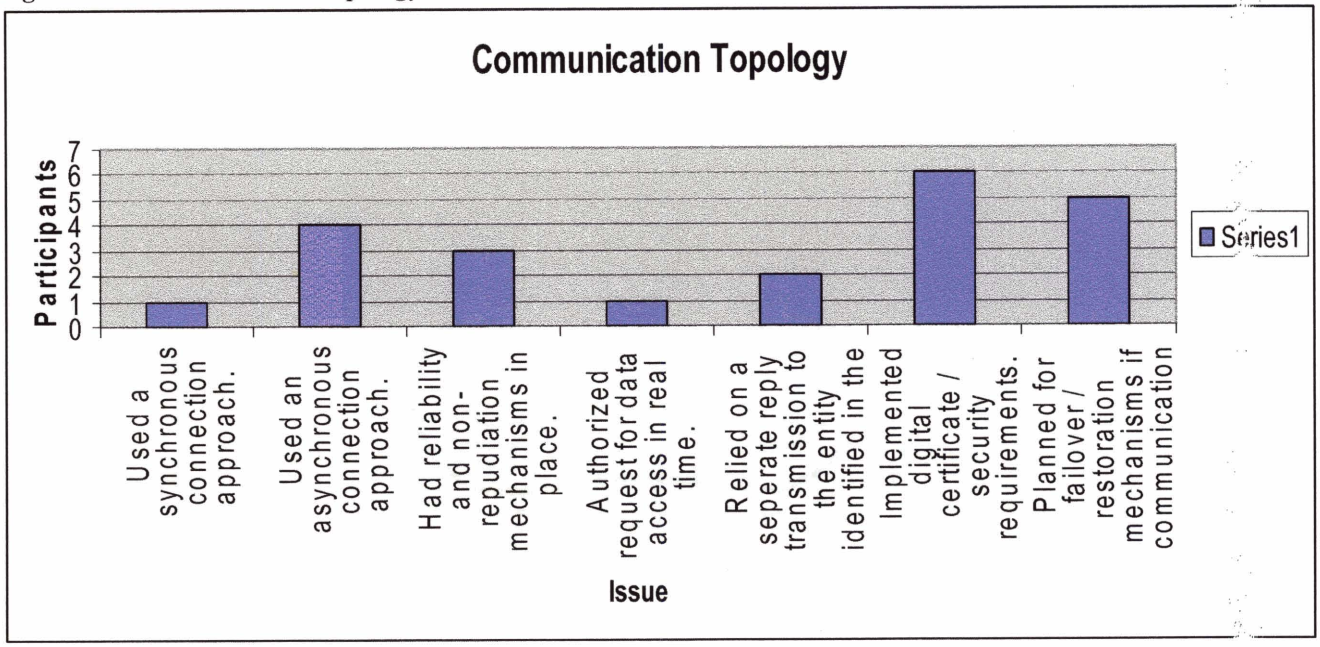
In the synchronous approach, a reply is required by the requestor prior to engaging in data exchange. Hence, correlation of the identity of the requestor and the authorization to access data requested by the query is essential. Carrying authentication information from the "transport" layer to the EPCIS application requires authentication to be significantly more robust and more time dependent when a synchronous request/reply process is used. It was observed widely that synchronous connections are highly brittle and can time-out and/or fail unless reliability and non-repudiation mechanisms are in place.

When an asynchronous request/reply approach is used (either via web services or AS2), the responder processes the query and then initiates a separate reply transmission to the entity identified in the query. At least one participant had resend processes in place to recover from an AS2 line failure. Their finding was that deterministic batch processes were much easier to administer and detect problems with. Another participant indicated that during each processing interval, a status verification was checked to ensure a re-send for any failed transmissions.

Based on the pilot results, a loosely coupled asynchronous architecture is recommended for more resiliencies. The response-reply type of event coordination is not unique to EPCIS/AS2. It is a typical situation in many business processes whereby a process needs to pause and wait for a manual intervention (e.g. a signoff) before it can continue. Many enterprises already have middleware orchestration tools that can be configured to handle these situations.

A summary of the communication topology related issues encountered during phase 1 of the data exchange pilot is given below.

Figure 21 Communications Topology



8.2 Project and Change Management

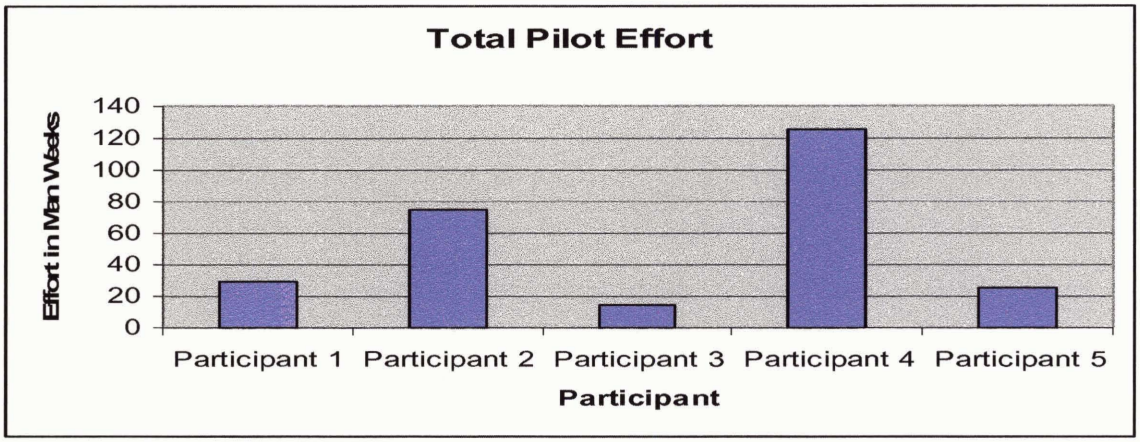
Any change within organizations involving a disruptive technology requires carefully detailed project management, change management and executive support for success. Given that RFID projects till date have had high visibility within companies, the need for a proper organization design and project management methodology to complement business process and technology changes is absolutely critical.

The results from the Fast Moving Consumer Goods (FMCG) Business Action Group (BAG) pilot projects suggest that early adopters of RFID systems have experimented with different organization designs and structures for their pilots. Since these pilot participants are the leading FMCG retailers or suppliers, each went in with the necessary executive support for RFID adoption. However, what was not so obvious was the fact that the motivation for RFID adoption did not always have consensus across departments and participants.

During a follow-up interview with one large CPG supplier, it was brought to our attention that the primary motive for the company's pilot program was to meet the mandate of a large US retailer. Hence, though the pilot project had the necessary executive backing, it was still used as a mechanism to meet mandates and ensure compliance. The organizational structure of this company's team reflected this fact.

The graph enclosed below shows the total pilot effort for five participants of the pilot, the roles for which are detailed later in this study.

Figure 22 Pilot Effort

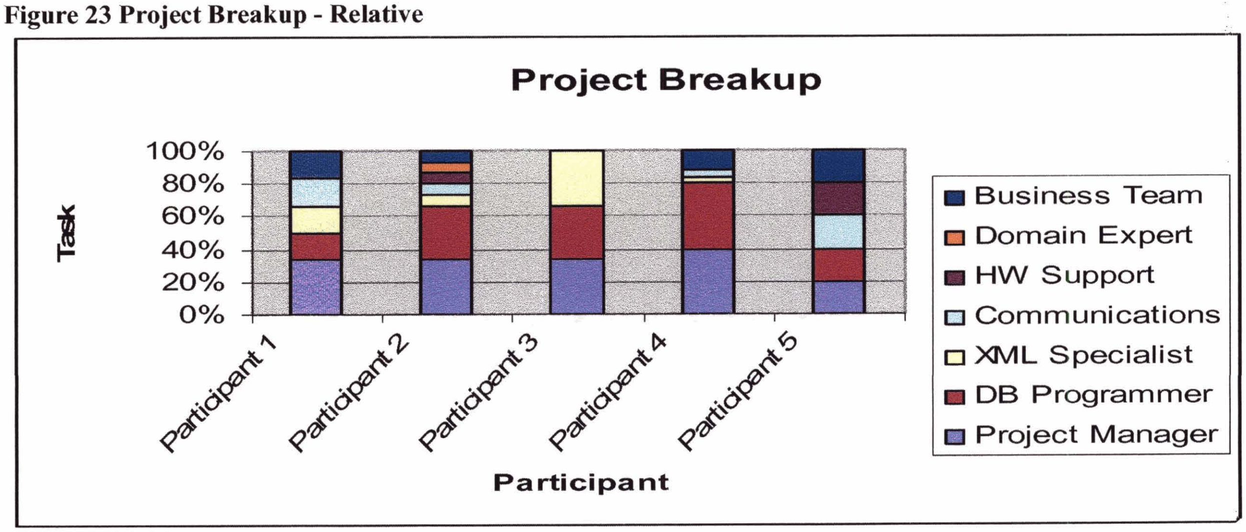


The total effort in man weeks was based on aggregating responses from participants to the amount of man weeks they estimated individual roles were involved in during the pilot. The scope of the pilot has varied from 15 man weeks to 125 man weeks of effort (it is worth noting the distinction between the retailer and supplier software development resource commitments) and reflects broadly the possibility of going in with a narrow and focused pilot to an extended pilot that involves possibly multiple objectives. The complexity of the project was also dependent on corporate data structures and the starting state with regard to clean EPC and SKU data for purposes of comparing results as to what was shipped and received. One participant that reported 125 man weeks of effort went in with 100 SKUs while another participant reported 75 man weeks of effort and had 20 SKUs in the pilot. Hence, one can infer that factors such as IT and software configuration, process re-engineering and project management influence the scope of the pilot in addition to the number of SKUs.

In terms of cost, even the most involved pilot effort at 125 man weeks translates to 625 man days or 5000 man hours. At an average rate of $100 per hour per resource, this would translate into $500000 for an initial pilot. New adopters should look at mapping out a resource plan and estimate costs for an RFID pilot accordingly. One key insight from the first phase of the data exchange pilot has been that RFID project managers have gone in for short and focused pilots that do not involve significant financial investments. This is so that they can demonstrate a quick return on investment and expand the scope of their RFID implementation incrementally.

A breakup of the effort by task for each of the participant is enclosed below.

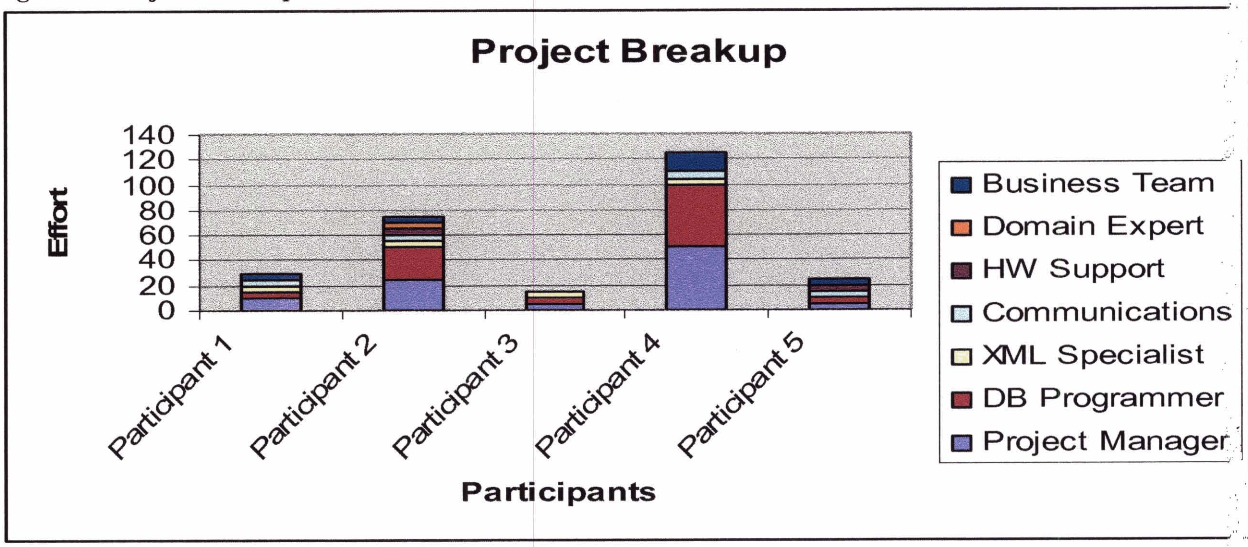
Figure 23 Project Breakup - Relative



The largest share of the project has consistently been on the staffing of project managers. This is closely followed by the database programmer and report writer effort.

Some of the participants have also had a relatively equal share of effort for XML specialists. However, since the total effort has varied considerably across the participants, one would also have to evaluate the resource allocation cumulatively. A breakup of the pilot effort relative to the total effort is enclosed below.

Figure 24 Project Breakup - Cumulative



Again, the effort for project management and database programming consistently account for the largest share of the total effort. Since most of the pilot participants also indicated that they were successful in receiving and storing EPC data, one can infer that most of the effort during the first phase of the pilot has been focused on overall project management and programming required to receive, store and report on EPC data.

Some additional inferences from the pilot results are enclosed below -

- All of the pilot participants had a full time staffed project manager.
- Of these, two project managers were involved only for five man weeks. This indicates that the project managers themselves may not have been full time on the pilot project.

- XML / Database programmers and communication specialists seemed to be involved for most implementations. This supports the focus of the initial pilots which was on ensuring an ability to exchange basic EPC data across the network.
- We were surprised to note that only one of the companies had a data quality analyst on board. The need for full time data quality analysts becomes increasingly evident as companies expand RFID implementations as part of a larger scale effort. Hence, at this stage that most companies are treating the pilot as smaller scope self contained projects.
- The results also indicate that none of the surveyed companies had an integration consultant / specialist as part of the core pilot team. This seems to indicate that RFID pilots were considered as proof of concept projects as against projects involving full integration scenarios.
- The presence of business teams in most of the efforts indicate that companies are tracking the pilot projects closely with the business case scenarios initially laid out.
- The lack of domain experts in the pilot staffing also indicates that companies are not yet ready to think about RFID systems as an enterprise wide change effort with re-engineered business processes. (The pilot project breakup graph contains the resource allocation used in the pilot.)
- The limited hardware and infrastructure resources for the pilot indicate the preliminary nature of these pilots. A larger roll out almost certainly would have required additional resources to manage the communication requirements, production system setup and maintenance, ongoing monitoring and so on.

Figure 25 Resource Plan

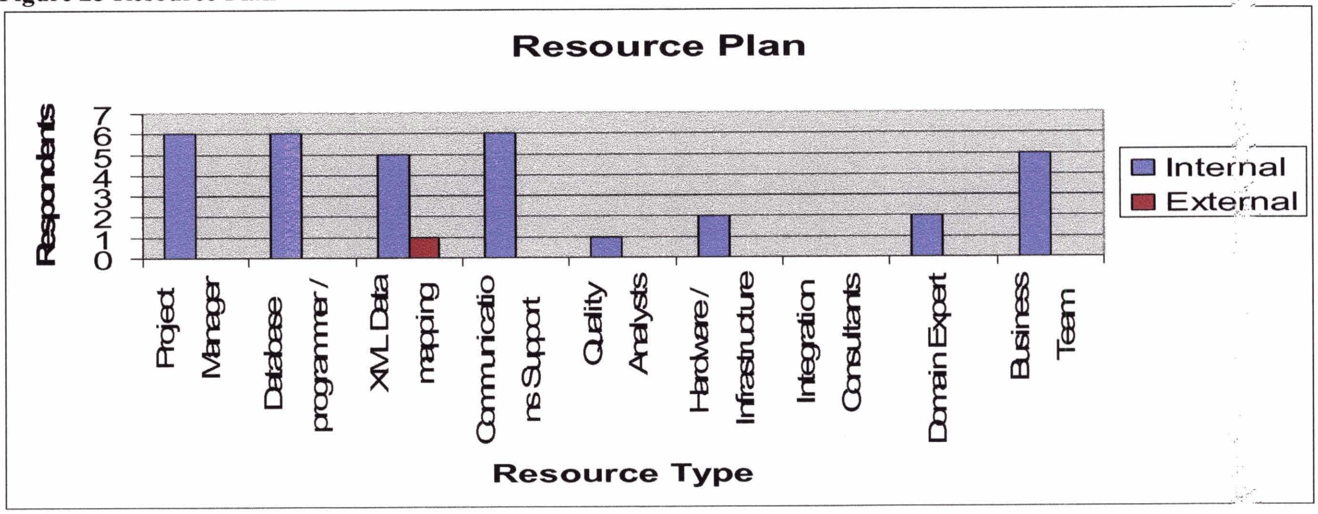
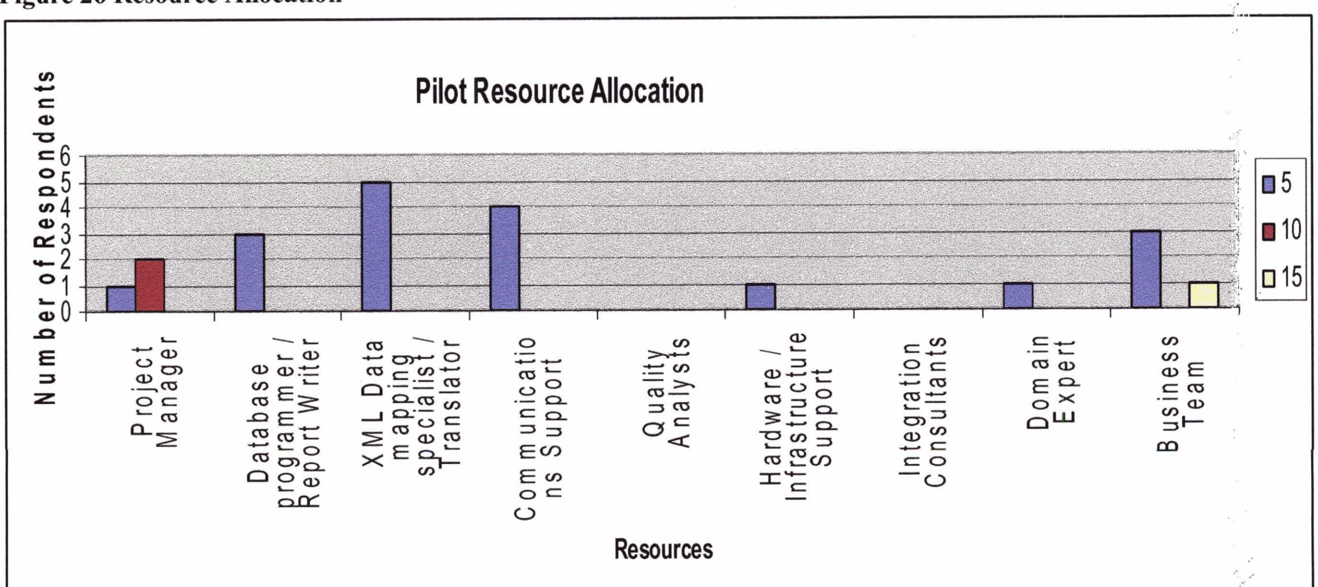


Figure 26 Resource Allocation



8.2.1 Analysis

The initial pilot objectives and key success factors could be summarized as below –

- Successful implementation of FMCG EPC Data Exchange Schema
- Validation of data requirements and vocabulary values/standards compliance (identify gaps and unnecessary defined values)
- Successful incorporation into business processes identified as areas of opportunity with RFID:
  - Map reads to vocabularies and have the ability to interpret and apply to business processes including:
    - Inventory Visibility
    - Shipping /Recieving
    - Proof of Delivery
    - Promo Execution/Reporting

The above observations confirm that the initial Data Exchange Pilot did not set out to validate RFID as a key enabler to company wide business processes. The principle focus was to develop and validate industry specific vocabulary for exchanging supply chain information status in a shared business process. However, since initial RFID pilots have been reasonable successes with respect to this objective, it now makes sense for the subsequent phase of pilots to include scope beyond basic compliance with retailer mandates and proof of concept. If new adopters can articulate business cases and integration scenarios well in advance, they could plan to include company wide participation if they have the appropriate organization structure in place. Moreover, with proper pilot planning, new adopters might be able to demonstrate the viability of a larger number of business cases including integration to enterprise applications and GDSN networks. However, the scope of RFID pilots still need to be kept small enough in the interim since companies will in all likelihood be proofing out their basic RFID and IT network infrastructural issues.

8.2.2 Recommendations

Key recommendations from the Data Exchange Work Group participants are the following –

- Go for a focused and narrow pilot effort that will validate specific scenarios that generate high value for the company.
- Break up RFID pilots into multiple phases and ensure that the scope of each phase builds on the success of previous phases.
- Build a core pilot team comprising of project managers, database experts, XML developers, quality analysts, integration consultants, domain experts and business analysts. The core team should ideally be staffed as a combination of intermediate and advanced level of expertise.
- Identify specific products for which an RFID pilot makes sense. These products should ideally be amenable to RFID hardware and infrastructure and should support the current economics involved in RFID tagging. Additionally, the product volumes should be scalable and should involve minimal disruptions to the supply chain and should lend themselves to testing various business scenarios.

- Identify and establish the key business cases and generate use cases for them. These use cases ideally need to go across multiple business functions and include integration scenarios. They also need to include specific workflows where an EPC code could be used to facilitate any of the RFID business cases.
- The use cases should be ratified, signed off and accepted by a core requirements generation team and an implementation team comprising of stakeholders from external vendors.
- The pilot team should work with the quality analysts in generating functional, system, performance and integration test cases.

A further recommendation based on an interview we had with a large retailer involves a unique approach that this particular retailer had taken in terms of organization structure. RFID implementation efforts are likely to be decentralized at large companies. This means that various business units and departments would decide based on their respective needs as to when to adopt RFID into their business processes. However, as RFID is a relatively new technology, the danger of such a decentralized approach is that associated learnings would have many elements that could be lost to others in the company. Hence, it makes sense to consider one central RFID division / strategy group to be formed that acts as a single point of contact for all divisions within an organization for RFID vendors to interact with. This centralized group would take responsibility for interfacing with external vendors, driving integration efforts, consolidating lessons learnt from each pilot and act as a consultant for individual teams looking to implement a pilot or a larger roll out. In fact, individual business units within an organization would be virtual customers of this centralized group. This practice worked extremely well for the said retailer and it is our belief that this model should be considered by many companies looking to adopt RFID technologies.

8.2.3 Change Management

In terms of change management, some of the key principles that companies followed during the pilot were to start with small implementations with a focused set of products. Since issues still exist with interference and read rates, companies should focus on selecting a set of products that lend themselves to testing with maximum success rate. The pilot should also be built on small successes. It is critical that the pilot is driven as part of an overall strategic change rather than a one off effort. Since companies typically face many pressures in terms of showing value internally, meeting external compliance requirements and so on, it is critical that the overall vision is not compromised due to project and schedule related pressures.

A change involving something like RFID needs to be carefully managed within the company to build the level of confidence to facilitate company wide adoption. Some of the early adopters had internal communication programs whereby the multiple stakeholders within the company were kept abreast of the progress of the pilot and even small wins were broadcast across the company.

8.3 EPC GDSN Implementation

It became clear during our discussions with the pilot participants and through the survey results that relating EPC data to information contained in shipping hierarchies including the Global Data Synchronization Network (GDSN) is a challenge. Three of the survey respondents indicated that their GDSN integration efforts were 'very unsuccessful'. Another three indicated that accessing GDSN was not applicable to them.

Given how critical it is for retailers and suppliers to maintain clean and synchronized product information, these results were intriguing. In fact, one of the key benefits those companies assumed when adopting RFID systems into their supply chains is that of information visibility and synchronization across the supply chain. Thus, it will be important to establish processes to ensure Product Information is up to date and in synch with their supply chain partners..

8.3.1 GDSN Basics

Companies require a certain amount of information about their products to be exchanged across various tiers of their supply chains. In the initial GDSN meetings a set of sixty product attributes were agreed to, including size, weight, color, lot number and so on[17]. However, these attributes and associated product information continue to grow as requirements for compliance with customs clearance codes, environmental hazardous material reporting, and other regulatory and trading partner requirements increase. Rather than each company exchanging data point to point with each other, it made sense for companies to collaborate and exchange data through a common registry or information repository. This led to the development of the Global Data Sync (GDS) network. The GDS network acts as a virtual 'phone book' for retailers and manufacturers through which they can query for product attributes[18]. The network provides data about basic product attributes and redirects users to a more detailed data registry or the

[17] EPCGlobal (2004). The EPCglobal Network and The Global Data Synchronization Network (GDSN): Understanding the Information & the Information Networks
[18] IBM (2005). EPC: A Shared Vision for Transforming Business Processes

manufacturer itself for detailed product attributes. The GDSN ensures that when various supply chain partners engage in collaborative activities (planning, forecasting and replenishment), the static data they reference is of high quality and standards at all times.

Static information conveys information about the class or type of a product and generic product attributes. For instance, a company could be trying to introduce a new brand of cereal. Static information would convey product attributes about cereals in general, specific types of cereals and information about specific locations where cereals can be found. This will be used by suppliers and retailers to reconcile invoices, ensure quality standards, plan for adequate lot sizing and replenishment policies. The GDSN system facilitates this by using the EAN.UCC system of standards and global identification numbers. The global identification numbers used involve the Global Trade Identification Number (GTIN) and the Global Location Number (GLN). GTIN is used to identify and exchange core product and services data while the GLN is used to exchange locations, commercial and legal entities and trading terms. Each company assigns and maintains its own set of GTINs and GLNs[19]. One important requirement to emerge from the EPCglobal FMCG Data Exchange Pilot is the need for a registry of company specific location identifiers, Serialized Global Location Numbers (SGLNs), as are being created by participants in the FMCG Business Action Group.

Each company would register its set of products with a data pool and authorize a certain set of trading partners to access the data. The data pool is essentially a repository of information about the product. Whenever any static information changed about the product, the company would go and update the product attributes in the data pool and this

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[19] Brock, D (2002). Integrating the Electronic Product Code (EPC) and the Global Trade Identification Number (GTIN)

would get synchronized with the respective trading partners. The information on which data pool to access is contained in global registries which have been recently consolidated across three primary vendors: GS1 One Synch, Agentris (formerly WWRE) and GS-X[20].

8.3.2 EPC Global Network

Other than static information, companies also need to exchange dynamic data. In the earlier example, dynamic data would refer to details about a specific lot or batch of cereals. Further, a company would also ideally like to know about the current location and all previous product movements. This level of granularity cannot be met through the GDSN network. The EPC Global network based on RFID is being designed to fill this void. The EPC global network would allow a company to track and trace a particular item and get to specific instance data about the item.

The EPC Global networks could work in the same way as does the GDS network except that the database sources are likely to be distributed rather than centralized in a single record store of all EPC read events. A system of record called the Object Naming Service (ONS) might be used to access information about where dynamic information about a specific Electronic Product Code (EPC) can be found[21]. An EPC is the global identifier for dynamic data about an item. From here, access to localized dynamic data is managed by the EPC-IS where companies can manage authorization for who has access to the dynamic data.

[20] EPCGlobal (2004). The EPCglobal Network and The Global Data Synchronization Network (GDSN): Understanding the Information & the Information Networks

[21] EPCGlobal (2005, Sep). EPC Information Services (EPCIS) Version 1.0 Specification

8.3.3 Role of GDSN and EPC Global

Both the GDSN and EPCglobal network have their own roles and associated benefits. However, for companies that are looking for collaborative trading, integrating the EPC global network and GDSN can make a significant difference. To illustrate this using an example, most companies typically plan their replenishment policies based on specific information about product attributes since determination of optimal lot sizes and batch quantities requires specific product data. However, if a company can reconcile product specific data with up to date information about the quantities available at each location, it would allow a company to plan its replenishment much better. Another example can be seen from the way companies manage promotions. Since promotion is tightly coupled with specific characteristics of a product, having quality information available through GDSN is critical. However, if a company can additionally monitor the progress of the promotional item at each point in time, it would have a much better sense of how its promotions are executing against plan. Thus, the value of integrating GDSN and EPC Global networks cannot be over-emphasized.

One of the key reasons companies were not successful in EPC-GDSN integration during the pilot was because of issues with conversion between EPC and GTIN and vice versa. Since GTIN is used to access the GDSN network, it is essential that companies can reliably and efficiently convert between the two. However, due to a combination of factors involving XML parsing and practices like packaging multiple data elements in one strong, several pilot participants faced problems mapping EPCs to GTINs. However, one also needs to note that EPC-GDSN integration was officially outside the scope of the first phase of the pilot. Our conversations with pilot participants indicated that they are indeed considering pursuing EPC-GDSN integration during the subsequent phases of the pilot. For new adopters, our recommendation would be to evaluate the importance of EPC-GDSN integration and scope out this effort if applicable as part of the first phase of the pilot. Further, conversion between EPC and GTIN could be the focal point during the pilot to facilitate the integration.

8.4 Distributed Query Model

Based on the specifications that are being deliberated in the EPCglobal Software Action Group EPC-IS Work Group, one of the key requirements for RFID users will be that of accessing distributed data across the supply chain. A distributed query model will help all stakeholders in the supply chain use a common set of standards to search and process data. A query is essentially a structured search request that provides certain input conditions. The response from a query is usually a set of data records that comply with the constraints set in the query. A query is useful when a supply chain partner wants access to selective data.

To illustrate an example, let's say a company wanted to determine how may EPCs it has for a certain item at a certain location. This is essentially an inventory snapshot. Here the inputs would include a GLN and a Serialized GTIN (SGTIN). The output from the query would a set of count of EPCs derived from quantity events. The returned data can further be filtered based on time, disposition and GTIN. A simple variant of this query can be used for promotional monitoring. For instance, if the query is modified to determine how many EPCs for a certain item passed a certain location during a certain time period, it can be used to monitor the promotional execution of an item that a manufacturer perhaps expects would have passed through a location onto the store shelf.

A few example queries similar to the above are enclosed below –

- All events for a given EPC.
- What locations were traversed by a certain EPC over a specific time frame?
- What is the location of an EPC in a recent time frame?
- In the future, more complex queries might be required such as what EPCs in a certain location are within certain weeks of expiration?
- What received EPCs have Advance Ship Notices and Purchase Orders generated?

Clearly, queries can be extremely powerful in deriving intelligence from within disparate data sources. Queries provide a requestor a mechanism to filter the data without requiring significant level of processing from the information provider. The real challenge arises when one has to combine data elements and query for data across multiple enterprises or data sources.

The current EPCIS specifications look to define a query interface where the transport binding could be via AS2 or Web Services. In fact, Web Services present a tremendous opportunity for companies to expose interfaces that can encapsulate and retrieve data[22]. Further, it is important for these services to support systems with large data transfers and latencies. The query interface model would primarily be asynchronous and could potentially be layered on top of existing data warehouses.

[22] Violino, B (2003, Oct). Linking RFID with Web Services, RFID Journal

It is also important to understand the burden that query interfaces would place on the information providers. Hence, it is critical that implementation of the query interfaces are straightforward and minimize the load on the service providers.

Considerable work is happening in this area as part of ongoing EPC-IS software specifications process as well as in the subsequent phases of the data exchange pilot. Though this was beyond the scope of the first phase of the pilot, we believe it will be extremely useful for new adopters to evaluate and understand the role Web Services can play in exposing standard query interfaces. We recommend that companies looking to adopt RFID systems define specific use cases and map out reports and data elements they would like to see. Subsequently, they can use the EPCIS query interfaces and extensions to aggregate and report the data for decision making purposes. It is also important for companies to start evaluating Web Services as a means to expose and query for data. Our interviews with several of the participants of the pilot supported this requirement and indicated their efforts to explore query interfaces and Web Services during subsequent phases of the pilot.

8.5 RFID Data Management

Almost all the pilot participants indicated that they were successful in staging and storing RFID data. However, subsequent discussions with some of the participants indicated that they are yet to integrate RFID data with a corporate wide Master Data Management (MDM) / Business Intelligence effort. Data management is increasingly becoming an area of focus for companies as they try to create a single version of truth for enterprise data[23]. However, except for the retailer participants, the majority of supplier respondents have not yet focused their efforts towards reconciling EPC data as part of a MDM system. Companies should not lose sight of the larger vision for a company wide MDM system. In fact, a large US consumer goods company we spoke to indicated that expanding the scale of their RFID implementation and data management systems would be a key challenge for them.

The case for a corporate wide MDM system is straightforward. Companies typically have complex IT architectures with combinations of legacy, ERP and supply chain systems dotting the data landscape. Given the individual data requirements of each of these applications, it is critical for companies to be able to feed the same version of data to all these systems. Companies are starting to follow a process by which they have a common master data area. All incoming data elements are staged first and run through validations or cleansing routines. The net change of the data from its previous state is computed and scripts are put in place to move the data into a sanctified master area. Data is also moved downstream into outbound areas from where standard integration adaptors can be used to integrate with downstream applications. The movement of data into master areas is also integrated with business processes like approvals and reconciliation.

Given the volume and context for RFID data, it is critical that companies follow a similar three staged architecture to stage, master and integrate RFID data. Given the fact that not all of the legacy applications would receive RFID data in the same format, it is imperative that a common medium of storing and integrating data is devised.

Our discussions with a large US consumer goods manufacturer also indicated that one of the key takeaways from the pilot was the need for software applications to start

[23] Wang, F & Liu, P (2005). Temporal Management of RFID Data.

receiving data in a standardized format. Companies already use commercially available integration brokers to receive external data. However, the software applications downstream are yet to implement adaptors for receiving this data. The consumer goods manufacturer we spoke to also indicated that they followed a model of co-development where they invested in the development of certain integration features of the software applications they were buying. We would recommend new adopters to consider this model of development. Data management and integration needs are crucial to realize the full value from RFID. However, many of the RFID focused software vendors are too early in their development cycle to be able to provide for integration adaptors that can receive EPC data in a standard format. Hence, if the retailers and manufacturers start working with these companies in a co-development mode to build and enhance these data management components, it would go a long way in building industry solutions.

9 Conclusion

Companies today use different systems for order management, warehouse management, transportation management, inventory management and event management to support their supply chain operations. Introduction of RFID data undoubtedly adds complexities to a network that is already multi-faced and complex in nature. Exchanging RFID data with a common vocabulary will eventually ease the integration of these systems and facilitate advancement toward a more collaborated supply chain. But this will not be possible without commitment, dedication and hard work from all stakeholders.

Many data exchange pilot participants still use a slap-n-ship approach in reality. Manufacturers merely place tags on the cases and pallets before shipping. However, these participants have realized that data exchange and synchronization are the keys to reaping RFID implementation benefits. What has evolved during the course of this pilot is a solid foundation for the many years of work ahead. We should not underestimate the effort behind the work even though the pilot only covered a limited scope. In the following sections, we will summarize our findings and draw insights into the business process as well as technical aspects.

9.1 Business Process Conclusions

We chose to focus on new products and promotions in particular because most of the participating companies expressed a view that monitoring of new product launch is an area they see RFID adding immediate value. The data exchanged between manufacturers and retailers provide a mechanism to drive business process changes. For example, the newfound visibility allows the manufacturers to see where their products are at any given time and also ensures that retailers have complied with the promotion execution instructions. Since Out-of-stock is the major concern for retailers, it is in their best interest to adhere to promotional compliance.

Based on the surveys and interviews we conducted several facts about the pilot participants and their associated business processes can be derived. The pilot showed results in data manipulation savings, reduction in unexpected data glitch issues, supply chain visibility, improved read percentage calculations, improved timeliness of data and new customer data exchange setup savings. The companies also addressed the anticipated effect of RFID in cycle time and dwell time improvements. In particular, RFID would bring improvements to restocking in a timely manner and help on time delivery. Also, RFID was seen as being particularly helpful with refrigerated goods that need to be shelved in the cold storage area.

However, the read rates of the pilot do not reflect upgrades to EPCglobal Gen II performance. For the most part, the read rates increased as goods flow through the backroom and then out to the sales floor. The drop in trash compactor reads indicated that even at that location, not all boxes went through the reader at the trash compactor. In terms of the data exchange element, pilot participants were instrumental in ensuring that the EPCIS specifications support a data field to include transaction IDs such as Bill of Lading or Purchase Order Number. This information will allow companies to understand which business context the EPC data is part of. Moreover, companies are excited about moving to a model of query communications since the users can ask information they are looking for. That means that they only retrieve information that is required instead of having to synthesize through a big file and manipulate data from various databases.

In addition to our surveys with the companies, other studies also support the importance of EPC data exchange. Wal-Mart's out-of-stock study and Gillette's "advantaged product" razors studies have both demonstrated how RFID can potentially recover lost sales when companies are able to closely monitor inventory levels. In the Wal-Mart case, retail stores replenished three times faster than with comparable items using standard bar code technology. This led to a 16% reduction in out-of-stocks. In the case of Gillette's Fusion razors, RFID data exchange for new product launch reduced the cycle time (from manufacturer DC to shelves) by as much as 11 days.

Though all these studies may be valid, we must consider the actual state of affairs within these companies. There are over 400 suppliers vying for retailer store managers to pay attention to their products. Is this realistic or feasible? The potential for quick replenishment and promotion monitoring is there. But because this process involves a large scale deployment, it is not likely that all manufacturers will gain the expected benefits from implementing RFID and exchanging data. There is currently not enough bandwidth to support the business process changes that might be required both at the manufacturer and retailer level.

In order to reap the rewards of RFID investment, suppliers and retailers must come up with creative ways to drive RFID business process improvement. Some 'Out of the box" thinking may be useful for pilot planners in envisaging a Supply Chain Paradigm Shift. Suppliers may think about negotiating with retailers as to how both parties can go about maximizing overall supply chain benefits. For example, manufacturers can design a contractual agreement based on which if retailers execute promotion above a certain level, then the retailers will receive a rebate or a discount percentage on the next batch of order. Another alternative is to shift the conventional wholesale price model to revenue sharing. Even more radically, manufacturers consider using RFID as a mechanism to drive stock-less inventory for retailers. That might provide huge incentive for retailers to ensure promotion execution.

9.2 Technology Conclusions

The pioneers of RFID systems hypothesized that the real value of RFID will be unlocked only when companies utilize RFID data to facilitate business processes. The FMCG BAG data exchange pilot validated this hypothesis to a certain extent. Though the scope and extent of utilizing RFID data is substantial, the data exchange pilot provided an important milestone in establishing consistent vocabularies and standards across trading partners. Further, the pilot also provided a test bed to resolve several technical and infrastructural issues and understand network and capacity requirements of RFID based systems.

One of the most important benefits from the pilot has to do with the development of a consistent business vocabulary and associated standards. The standardization of this business vocabulary will go a long way in providing the scalability when expanding collaborative data exchange efforts across a larger set of partners. Moreover, the consistency in business document formats will reduce the setup, development and implementation efforts. It is clear that RFID data will be much easier to handle when exchanged using standardized formats.

It is also evident that companies need to understand the importance of master data management and the need for a framework to be established. The ability to stage and store, validate and cleanse data becomes crucial since it is likely that RFID data would become the focal point of an enterprise wide integration effort in the future.

Not all pilot participants were able to implement EPC-GDSN integration. Conversion issues between EPC and GTIN and vice versa were the biggest issues in implementing this integration. New adopters need to be aware of the potential benefits of having a system in place that can facilitate static and dynamic data harmonization. If this is construed as adding significant value, new adopters would need to plan for additional scope and effort to manage EPC-GDSN integration.

Though integration with IT systems was not accorded the highest priority during the pilot, it is clear that companies will need to start planning for legacy integration at some point before real ROI can be realized from RFID.

Infrastructural issues such as XML parsing, AS2 circuit configuration, EDI software gateway support and so on assume added importance during the initial setup of an RFID based system. New adopters need to be aware of these challenges and would have to plan for such issues as part of their pilot planning.

It also became apparent during the pilot that suppliers need considerable bandwidth to support packaging lines for production levels of a limited number of SKUs. Thus, new adopters would need to be aware of the strains on their physical infrastructure as a result of RFID.

New adopters would also do well to setup the appropriate organization structure and design to support an RFID pilot. It is critical to staff the project with the right project management resource as well as a cross functional team comprising of representatives from various technical and business backgrounds. It is also important that companies manage change appropriately since RFID is a disruptive technology that can impact several parts of the enterprise. A strategy that seemed to have worked well during the pilot was to have a central team coordinating all RFID efforts across the company. This ensured that best practices and learning from independent efforts were across the board.

The pilot project also highlighted the need for adoption of data mapping and translation technologies such as Web Services. The distributed query model is one such architectural challenge when considering how to use RFID data integrated with business rules spanning corporate databases. A technology such as Web Service would be perfectly suited to facilitate this and is an area that could be on great interest to new adopters.

Though the pilot project is a first step towards realizing the vision of an "Internet of Things", it is an important milestone since it brought together some of the largest retailers and suppliers in a collaborative data exchange effort. It is heartening to note that all the pilot participants indicated that they would classify their pilot as a success. Though industry experts have for long agreed that RFID holds great promise, it is perhaps the first time that businesses are beginning to sense that the RFID vision might become a reality in the near future.

The power of this idea was never in question. But, perhaps, its time has indeed come.

Bibliography

Definiton of EPCglobal, Wikipedia, http://en.wikipedia.org/wiki/EPCglobal Accessed Mar 31, 2006

Definition of GTIN, http://www.gs1.org/ Accessed March 31, 2006

Definition of ONS, http://www.epcglobalinc.org/EPCglobal_ONS_1.0.pdf Accessed Mar 31, 2006

eRoom documentation of FMCG Business Action Group Data Exchange Work Group

EPCGlobal (2005, Sep). EPC Information Services (EPCIS) Version 1.0 Specification

EPCGlobal (2004). The EPCglobal Network and The Global Data Synchronization Network (GDSN): Understanding the Information & the Information Networks

"Full-Shelf Satisfaction – Reducing Out-of-Stocks in the Grocery Channel," Grocery Manufacturers of America (GMA)
http://www.gmabrands.com/industryaffairs/docs/execsum.pdf
Accessed March 31, 2006

IBM (2005). EPC: A Shared Vision for Transforming Business Processes

IBM for Grocery Manufacturers Association (2006, Apr). EPC/RFID: Proposed Industry Adoption Framework. Manufacturer Survey and Pilot Learnings to Date

"Proctor & Gamble, Gillette Merger Could Challenge Wal-Mart RFID Adoption," (Jan 31, 2005), ExtremeTech.com, 2005 Ziff Davis Media Inc

Bonasera, J. (2002, March). New Advertising, Marketing, and Promotion Management Processes and Application Will Give Retailers More Control in Creating Demand and Higher Returns, AMR Research

Brock, D (2002). Integrating the Electronic Product Code (EPC) and the Global Trade Identification Number (GTIN)

Browning, T.H. (1985) The Effect of Post Harvest Temperature On The Quality And Shelf-Life Of Iceberg Lettuce, The Campden Food Preservation Research Association

Chen, Y. (2004). Getting Ready for RFID: Growing Use of Radio Frequency Identification Technology Presents New Challenges and Opportunities to Operations Research Professionals. OR/MS Today, v31 i3 p30

Fisher, M.L. (1997). What is the Right Supply Chain for Your Product? Harvard Business Review, March-April, pp. 105-116.

Garf, R. (2004, June). Retail Promotion Optimization and Execution Must Be Linked, AMR Research

Garf, R. & Presland, L. (2004, Sep). Retailers and CP Companies Travel the Last Mile of Promotion Execution, AMR Research

Grant, J. (2006, March 8). Gillette's Fusion at Cutting Edge of Trading Up CONSUMER GOODs. The Financial Times, p20

Hoovers Online

Kang, Y., Gershwin, S. (2004). Information Inaccuracy in Inventory Systems: Stock Loss and Stockout, IIE Transactions, v37 i9 p843

Kotler, P., & Armstrong, G. (1996). Principles of Marketing. New Jersey: Prentice Hall

Lee, Hau et al. (2005). Assessing the Value of RFID Technology and EPCglobal Standards for Consumer Products Manufacturers, EPCglobal US

O'Connor, M (2006, Mar). Gillette Fuses RFID With Product Launch, RFID Journal, http://www.rfidjournal.com/article/articleview/2222/1/1/

Preslan, L., Romanow, K., Cecere, L., & Garf, Rob. (2005, Feb). Promotion Effectiveness: More Important Than Ever for Consumer Products Companies, AMR Research

Scott, K., Romanow, K., & Johnson, R. (2003, July). Trade Promotion Management: What Are You Waiting For? AMR Research

Steckel, J., Gupta, S., & Banerji, A. (2004). Supply chain decision making: will shorter cycle times and shared point-of-sale information necessarily help? Management Science, v50 i4 p458

Underwood, V. & Keske, S (2004 Nov). Use Case Analysis: Data Exchange/Inventory Visibility, EPCglobal Business Action Group

Violino, B (2003, Oct). Linking RFID with Web Services, RFID Journal

Wang, F & Liu, P (2005). Temporal Management of RFID Data

Wilson, M. (2006, Feb). Promotion Management, Chain Store Age v82 i2 p63(1)