Paper 353-2008

Issues with Supply Chain and RFID in the Retail Industry

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ABSTRACT

The retail industry is experiencing problems in the supply chain because there is no formal collaboration between the retailer and supplier. Demand uncertainty in the supply chain, known as the "bullwhip effect," results in excess inventory and inefficiencies in the supply chain. Demand forecasts and orders are often distorted unless they are developed jointly by the partners.

These factors create a need for supply-chain integration and a way to provide supporting collaborative forecasting and replenishing processes, with the goal of increasing sales and reducing inventory investments and cycle time. Collaboration can reduce waste in the supply chain, but it can also increase market responsiveness, customer satisfaction, and competitiveness among all of the members of the partnership.

Radio Frequency Identification (RFID) provides a major advantage to supply chain management. Implementing supply chain collaboration along with RFID can enable retailers to achieve the best level of business performance. Retailers can expect extensive inventory and labor-cost savings. RFID has the most potential to offer in streamlining the value-chain management, but handling the amount of data by RFID in the retail industry limits the potential of RFID benefits.

SAS solutions are built on a solid framework of data management and analytic technology that can scale to any size database—even those that contain the expected massive amounts of RFID data. SAS® Retail Intelligence Solutions is RFID-compliant and can handle huge RFID data, which adds to the benefits of supply chain collaboration and RFID.

SUPPLY CHAIN PATH

The traditional retail supply chain consists of all the parties involved directly or indirectly in fulfilling a customer request, including manufacturers, suppliers, transporters, warehouses, retailers, and the customers themselves (Chopra and Peter 2004). Each retail supply-chain entity includes functions like product development, marketing, operations, distribution, finance, and customer service. The only information that is available to the supplier is the purchase order issued by the retailer. Because there is no overall picture of the external demand that is placed by customers, inventory can increase at every level of the supply chain. The main goal of each member of the supply chain is to reduce unwanted inventory levels and increase ROI (Matthias, Stephen, Jan, and Johanna 2004).

Suppliers and retailers have observed that at any given time inventory levels and back-order percentages vary significantly, even though customer demand for specific products does not vary much.

Consider a four-stage supply chain that involves retailer, wholesaler, distributor, and manufacturer.

In this scenario, the retailer reacts to increased customer demand for an item and places an order to the wholesaler. The wholesaler receives the order from the retailer and places an order to the distributor. To determine the order quantities, the wholesaler must forecast the retailer's demand. If the wholesaler does not have access to the customer's demand data, which is available to the retailer, the wholesaler uses orders that were placed by the retailer to make forecasts. This does not necessary reflect customer demand, and it could result in the wholesaler carrying more stock than the retailer needs or maintaining higher than necessary inventory levels to meet the same service level as the retailer.

The same scenario is carried out by the distributor and the manufacturer, resulting in even higher inventory levels and therefore higher costs at these facilities. The effect of increasing levels of inventory and the cost associated with them from the retailer to the manufacturer, without considering the actual customer demand, is called the "bullwhip effect."

Even small fluctuations in demand or inventory levels of the retailer in the chain are propagated and enlarged throughout the chain. Because each company in the chain has incomplete information about the needs of others, it has to respond with a disproportional increase in inventory levels and consequently an even larger fluctuation in its demand relative to others down the chain.

There are additional conditions that influence the bullwhip effect:

- Traditional inventory management uses demand forecasting to calculate the quantity of inventory because demand is uncertain in most situations. The optimal order quantity that is calculated using demand forecasting also leads to the bullwhip effect.

- With longer lead times, a small change in the estimate of demand variability implies a significant change in safety stock, record level, and therefore in order quantities.

- Batch ordering of inventory that is initiated by the retailer to the wholesaler results in a large order, followed by several periods of no orders, followed by another large order, and so on. The wholesaler sees a distorted and highly variable pattern of orders, which can increase lead time if there is sudden demand for a product.

- Price fluctuation can also lead to the bullwhip effect. If prices fluctuate, retailers often attempt to stock up when prices are lower.

- Inflated orders placed by retailers during shortage periods tend to magnify the bullwhip effect. Such orders are common when retailers and distributors suspect that a product will be in short supply, and therefore anticipate receiving supply proportional to the amount ordered. When the period of shortage is over, the retailer goes back to its standard orders, leading to all kinds of distortions and variations in demand estimates (David, Philip, and Edith 2000).

Each partner in the supply chain develops his or her own best forecast. Because all parties work in isolation, there is no coordinated input from the other supply chain partners for example, distribution centers, and manufacturing plants). More significantly, the consumer, who is arguably the most important supply-chain participant, was completely left out of the planning equation (NuThink, Inc 2001).

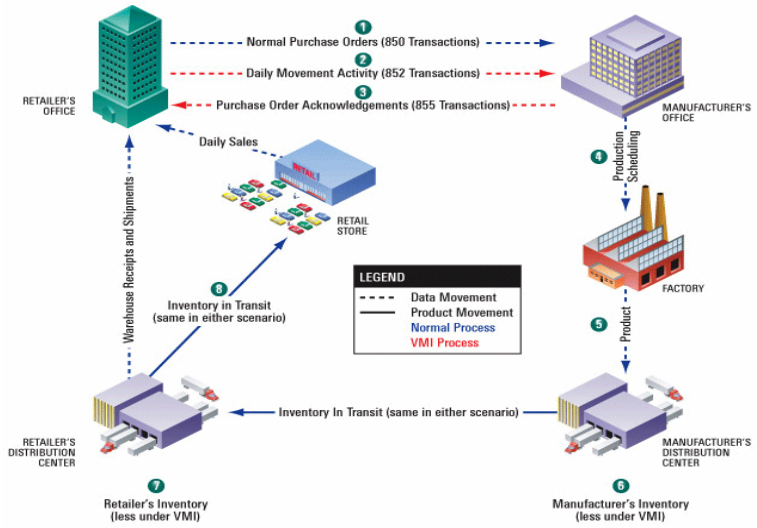
The retail supply chain presents many challenges that have generated numerous attempts to solve them efficiently and effectively. The use of store level, time-phased planning has an enormous impact on minimizing the effect of these challenges while increasing sales and reducing supply chain costs. Using time-phased planning processes and tools to integrate the retail stores into the supply chain is the final piece in creating a truly consumer-driven, high-performance retail supply chain. Integration between different members in the supply chain gives a vertical integration among them.

SUPPLY CHAIN INTEGRATION

The performance of the supply chain can be improved with the integration of various tiers in the chain. Integration is a prerequisite for effective sharing and use of information between different companies in the chain.

Vendor Managed Inventory (VMI) is an arrangement where the supplier, not the customer, decides when and how much of the customer's stock is replenished. It is a way to cut costs and keep inventory levels low throughout the supply chain. VMI focuses on assuring that products are stocked in the most efficient way, without manual information such as orders having to be transferred between customer and supplier. Instead, automatic electronic messages are used to keep track of the current stock situation and planned sales forecasts, and determine when it is time to refill the stock and avoid stock-outs.

Another interesting issue that is part of the VMI process is whether the customer should be invoiced directly at shipment or after selling the products to their own customers. This concept is called consignment stock. By definition, consignment stock is a marketing arrangement in which physical control of merchandise, but not title, is transferred from one business (the consignor) to another (the consignee). As consignee, the title to the goods remains with the consignor until the goods are sold. As a result, consignment stock might not be shown as an asset in the consignee's books (Matthias, Stephen, Jan, and Johanna 2004).



The vendor takes the responsibility to replenish and maintain a pre-defined inventory level. The purpose is to optimize the material flow by giving the vendor more responsibility and insight into the customer's forecasted needs and consumption. This responsibility has to be clearly defined in the agreement. VMI can be said to combine information technology and integrated computer systems, with JIT deliveries to provide the right product at the right place and time. VMI can take several forms depending on the level of responsibility the vendor has and the degree of integration. The purpose of VMI is to bring benefits for vendors as well as for customers. With increased insight into the customer's actual demands, the vendor can make necessary production adjustments more easily, and costs can be reduced for both parties (Leif 2006).

Integration explicitly ensures that buyer and seller computer systems are tied together. As the buyer sends POS or demand data to the seller, the seller automatically creates a shipment to fulfill the buyer's needs. This is a single-directional flow of information. There is no collaboration. It is a series of discrete, one-way flows of information that is used as is unless it does not get processed by the systems in place. The implicit assumption is that the buyer-seller business processes were synchronized. This is the failing of most standard Integration processes such as Vendor Managed Inventory (VMI) and Quick Response (QR). Systems integration is achieved, but business integration is not, which creates a need for supply-chain collaboration in the retail supply chain.

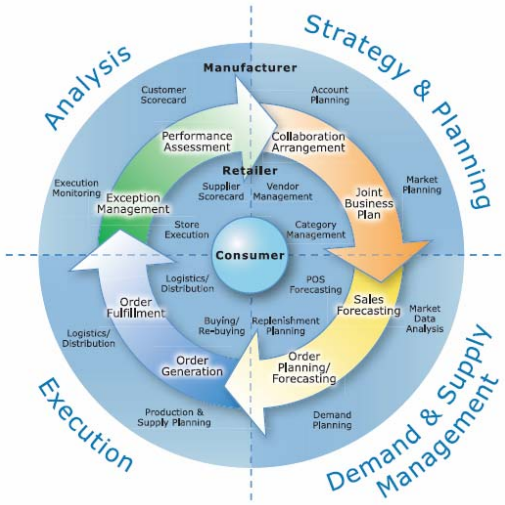
SUPPLY CHAIN COLLABORATION

Collaboration is defined as two or more companies sharing the responsibility of exchanging common planning, management, execution, and performance-measurement information (Anthony, 2000). Collaboration gives suppliers a better understanding and ability to cope with demand variability—an important feature when you are trying to counter the costly bullwhip effect (Disney, S.M, and Towill 2003).

The critical step that many companies have not been able to take so far is to incorporate customer-demand information into their production and inventory-control processes. Companies that collaborate typically exchange information on a high level, but the production planning process remains unchanged, which eliminates the opportunity for a radical improvement of the dynamics in the supply chain. In our view, the critical feature is not only to exchange information, but to alter the replenishment and planning decision structure. The demand at the retailer drives the combined inventory and production control process, together with feedback on complete supply-chain inventory, rather than at individual tiers in the supply chain (Matthias, Stephen, Jan, and Johanna 2004).

Manufacturers must secure and emulate the cooperation and dedication of relevant supply-chain partners to adapt in the most cost-effective way. Effective adaptation requires nearly real-time access to reliable, dispersed information to make quick, accurate, proactive decisions that can dramatically improve supply-chain performance. True collaboration goes far beyond sharing forecasts and automating the purchase order (PO) process. It requires sharing data regarding sales orders, manufacturing runs, inventory levels, and purchasing activities.

One solution for this particular task is called the Collaborative Planning, Forecasting, and Replenishment (CPFR) process. CPFR is defined as “an initiative among all participants in the supply chain intended to improve the relationship among them through jointly managed planning processes and shared information.”



The Strategy & Planning cycle establishes the ground rules for the collaborative relationship, determines product mix and placement, and develops event plans for the period. The Demand & Supply Management cycle projects consumer (point-of-sale) demand, as well as order and shipment requirements over the planning horizon. The Execution cycle places orders, prepares and delivers shipments, receives and stocks products on retail shelves, records sales transactions, and makes payments. The Analysis phase monitors planning and execution activities for exception conditions, aggregates results, calculates key performance metrics, shares insights, and adjusts plans for continuously improved results. While these collaboration activities are presented in logical order, most companies are involved in all of them at any moment in time. There is no predefined sequence of steps. Execution issues can impact strategy, and analysis can lead to adjustments in forecasts.

This clearly illustrates that CPFR complies with the supply-chain collaboration principles, yet there are issues that hinder the development of true supply-chain collaboration. There is a gap between the true customer demand and the inventory at any time. There is still no visibility of the product through the supply chain; the retailer still experiences out-of-stock conditions; and customers are unsatisfied (VICS CPFR Advisory Team 2004).

RFID AND RETAIL SUPPLY CHAIN

RFID refers to a set of technologies that are used to identify and transmit information from tagged objects by making use of radio waves. This technology is primarily used for automatic data capture and has the potential to revolutionize business performances and change how businesses operate today. It uses a tag embedded with a silicon chip and an antenna that enables it to communicate with a reader. The tags that are affixed to cases, pallets, or other units transmit radio frequency signals when they are present in the read zone of a reader. The reader picks up the signal and decodes it. This information is then matched with record data in the host computer system and transferred to the database for storage and analysis (Jansen, 2006). The RFID system has three major components: the tag; the reader; and the host computer system, which consists of the software (also known as middleware) that provides the core functionality of converting data that is collected from the tags into useful information (Mithu, Chao-Hsien, Tracy 2007).

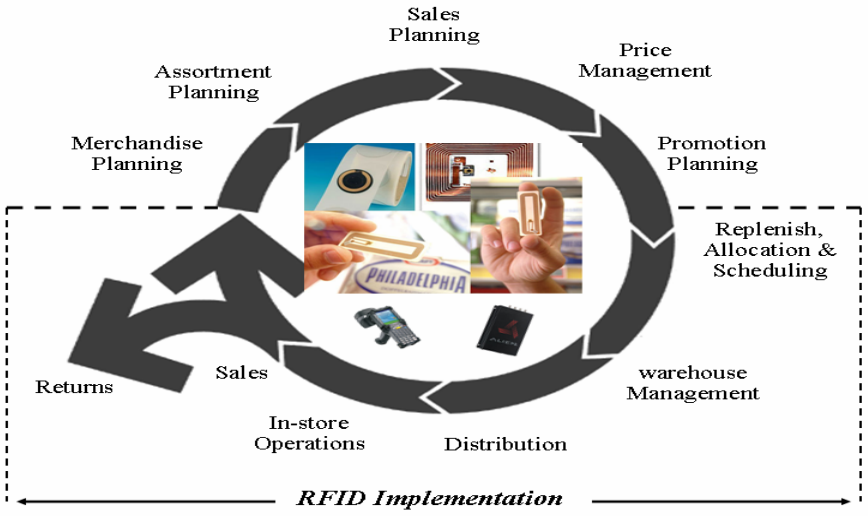
RFID holds great promise for all parties in the extended supply chain:

- For manufacturers, RFID enables detailed, automated monitoring of parts as they move through a facility. RFID quickly identifies the origin of defective components or products, even after they have been sold.
- For distributors, RFID manages inventories and fleets so effectively that manual tasks can be eliminated, processes can be dramatically accelerated, and shipping errors can be reduced.
- For retailers, RFID ensures appropriate stocking levels, tracks the origin and history of products, prevents theft or misplacement of goods, and speeds up checkout lines.

Where traditional bar coding requires one-by-one scanning of a visible bar-code label, RFID readers can simultaneously scan hundreds of tagged items, regardless of whether the tag is visible. And whereas traditional bar coding can tell you only what type of product is being scanned, RFID can uniquely identify individual items.

The use of RFID in the retail supply chain for tracking and tracing products can lead to reduced inventory and better collaboration among different players in the supply chain (Wamba et al., 2006). Most of the major retailers today see the potential of RFID technology to better integrate their supply chain and improve their efficiency by reducing error rates, which can cut down the overall cost of operations significantly. The benefits of RFID for the retail industry revolve primarily around improved supply-chain management. Improved visibility, which is the second most significant benefit of RFID for the retail sector, helps to achieve a tighter and more integrated supply chain.

Looking at the figure below, we can see that most of the dominant RFID benefits concentrate at the lower end of the supply chain.



RFID can be used in stockroom locations to solve inventory problems. Many retailers have a more difficult time finding inventory in the stockroom than on the store floor. If the stockroom is automated to track all items and to provide the exact location, restocking is greatly simplified and the number of out-of-stock items

in the store selling area could be reduced. Having accurate information about store stock can also reduce overall inventory levels. Out-of-stock conditions don't always occur because customers have purchased items. Items are often put in the wrong place by consumers or store personnel. This is a problem for all retailers, but it is especially problematic in the clothing industry. RFID allows store personnel to locate misplaced items and put them in the correct location. RFID inventory shelf systems can be tied into electronic shelf labels. As items are moved around in the store, the RFID systems can automatically determine what product has been moved and update the electronic shelf label with pricing and product information.

A mobile inventory-management system is an alternative to wiring all of the shelves and installing a large number of readers throughout the store. A store employee would use a mobile RFID reader that reads all items and shelf locations. The shelves would have their own RFID tags to provide the location information. Some day, a robot could automatically go down the aisles and take inventory. Product recalls could also be automated. The RFID tag can flag items at checkout, and recalled products can be replaced before they leave the store. RFID-enabled automatic registration could provide consumers with information if a recall occurs after purchase (Simson, Beth 2005).

THE DATA CHALLENGES OF RFID

For all of its promise, RFID still faces some technical constraints. Standards are still evolving, tags and readers are expensive, and some products and environments have made tag reading problematic. Although second-generation standards and technology improvements are rapidly resolving these issues, some challenges remain for those who must capture and digest RFID data.

EXPONENTIAL INCREASES IN DATA VOLUME

A typical RFID tag might contain just a few kilobytes of data, perhaps just a 96-bit EPC code that stores the most basic information about the tagged object. Tags can, however, store much more information (such as movement among locations, pricing and ordering history, and environmental conditions). Furthermore, a single RFID reader can transmit data from up to 800 such tags per second. Data points can add up fast. If the company wants to track individual products at multiple checkpoints, RFID has the potential to generate 100 to 1000 times the data volume of conventional bar code technology. Wal-Mart is looking at generating some 7.5 terabytes of RFID data per day—a volume that could easily overwhelm some systems and data warehouses.

FILTERING OUT UNWANTED DATA

Many events tracked by RFID systems will be irrelevant to your operational and intelligence systems. For example, it might be relevant that a chilled product passed a designated checkpoint at 30ºF on its way to the mixing station, but it doesn't matter what temperature the empty container registered when it passed by the same reader on its way to recycling. Other events will be irrelevant at face value, but essential for the hidden intelligence they will later reveal.

When the system is capturing massive amounts of streaming data every second, how do you separate the signal from noise? How do you filter through the information you really need to gather and keep for business systems and intelligence? Data management systems require flexible rules to organize, filter, and cleanse input so that systems will not drown in nonessential data.

INTEGRATION WITH EXISTING SYSTEMS

To reap the real benefits from RFID, companies must effectively integrate RFID data into existing supply chain management (SCM), customer relationship management (CRM), and enterprise resource planning (ERP) applications. This will entail new transaction types and data formats, and new correlations between EPC numbers and internal inventory numbers and UPCs — transmitted in real-time XML rather than batch EDI (electronic data interchange). Data management and integration processes will have to move more nimbly and flexibly than today's bar-coding systems require.

FINDING THE BUSINESS VALUE IN THE DATA

Companies make a mistake if they implement RFID as a "slap-and-ship" process, slapping labels on a product and shipping it out the door just to meet downstream expectations. The real value of the technology, the real ROI, will be found in exploiting RFID data to optimize processes and relationships. RFID makes it possible to gather new information from internal places and processes, more quickly and in greater detail. It provides visibility into the extended supply chain, from suppliers to manufacturers to distributors to retailers and even customers. It tracks items in more places, without human intervention, which makes it possible to deploy new features and applications. Smart companies will use this information to run the business more efficiently and profitably. But how?

DATA SHARING AMONG DIVERSE USERS AND ORGANIZATIONS

The promise of RFID is that information about products can flow across the extended supply chain. Participating organizations will therefore face new requirements for creating and sharing detailed information for each EPC number, such as product identifiers, manufacturing data, expiration, lot tracking, pricing, and customer-order information. Data exchange will be more complex than the EDI interchange of UPC codes.

Some organizations will use a central clearinghouse for this process; others will be so wary of privacy concerns that they will use peer-to-peer processes. Chances are, your IT systems will need to accommodate a variety of processes and protocols. There is also the human factor to consider. Data will not be very useful unless it is available where and when it is needed, and presented in a format suitable for the needs of very different types of users.

RFID systems hold great promise for retailers, manufacturers, third-party logistics providers, and other organizations. Analysis of RFID data can help these organizations reduce inventory uncertainty and increase efficiency in their supply chains, make better use of corporate resources, improve customer service, and get a broader and more complete view of their internal operations.

The amount of data that will be generated eventually by RFID systems is truly staggering. As RFID technology becomes more and more widespread, companies that adopt it will face the challenge of bringing together and managing huge volumes of RFID data. These companies will need to differentiate between meaningful data and vast amounts of "noise" in very large databases.

This creates a need for efficient business-intelligence software to extract, transform, organize, and clean the data for analysis to distinguish between what's important from what's not, to uncover patterns and trends, and to identify opportunities for improvement.

The business intelligence (BI) will be only as good as the tags. We have identified numerous discrepancies and we highly recommend profiling RFID data and incorporating it into a data-quality program. It is interesting to note that the originating plant, company, and processes will tag the item once and for all so inter-country cooperation is essential. The EPCIS helps standardize this cooperation.

PROCESS REENGINEERING

RFID implementation in the supply chain necessitates a need for three types of process reengineering: network-business, package, and site-business process reengineering. Reengineering is needed to improve and automate the business processes and to integrate the RFID data into SCM, ERP, and other enterprise applications. Some suppliers were wise to set up an RFID infrastructure pilot study to determine how much it would improve business processes, productivity, and operational efficiency. They tested servers, networks, and data synchronization from various readers into the servers.

In addition to network-business process reengineering, some suppliers have found that the shape and size of the product can affect the optimal location for tags on cases and pallets. Close proximity of tags to the liquid portion of each product inside the pallet and case will experience more interference from the liquid than the tags placed farther away from the offending material. Package reengineering can be used to reduce the amount of interference by finding the optimal location for tags on cases and pallets.

Site-business process reengineering deals with the reduction in labor and process times in handling the everyday tasks of loading pallets onto and from the dock, which allows better use of personnel for loading and unloading operations (Judith 2006).

SUPPLY CHAIN AND RFID TO THE NEXT LEVEL – TRANSFORM CUSTOMER DATA TO PROFIT

The sluggish sales that have dogged the nation's retailers this year are the result of two different sets of problems: consumers are cautious as they pay more for gasoline and watch their home values fall; and the stores just do not seem to have the merchandise that people want to buy. Stores should not blame all of their problems on macro-economic conditions. Even teen retailers like Pacific Sunwear of California Inc. and Wet Seal Inc., which tend to be less vulnerable to the whims of the economy, had a bad situation. That suggests to analysts that stores are not serving up the most exciting products.

2007 retail sales clearly illustrated the need for the combination of current supply chain capabilities and RFID towards increasing the value of the customer relationship. Retailers need to anticipate and shape

future demand to come as close as possible to satisfying each customer's unique needs. Achieving this at a detailed level requires automated processes enabled by scalable solutions with the latest in predictive analytics and optimization capabilities. The ultimate goal is more than having the right product in stock at the right price; it's about tailoring the entire shopping experience to create an emotional bond with the customer. In effect, this means turning today's multi-channel retail enterprise from "the store" into "my store" in a consumer's eyes.

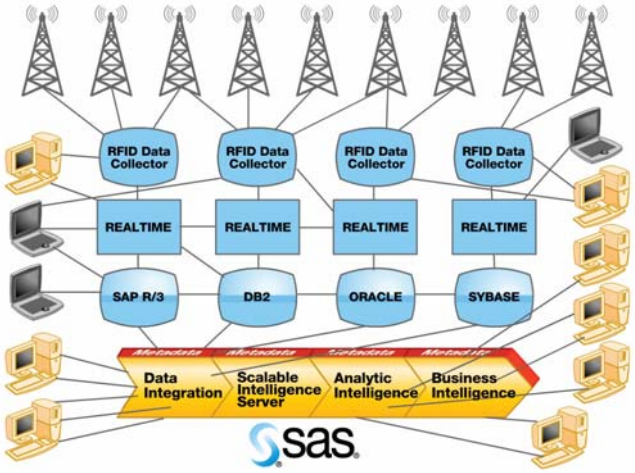
To fulfill the "my store" promise, the in-store and online shopping experience must meet the expectations that are created by marketing. The most important ingredients are the components of the merchandise mix, such as assortment, inventory, price, promotion, and space planning. Of course, in-store service and décor are important, but multiple research studies indicate that customers need to find the items they want easily at a reasonable price on each shopping visit. A retailer will not remain "my store" for long if a shopper never finds what he or she is looking for.

Merchandisers can stop thinking in terms of what product "we should sell" and instead come closer to satisfying each consumer's unique demand.

SAS CAPABILITIES FOR RFID AND CONSUMER EXPERIENCE

SAS, the leader in business intelligence, is uniquely equipped to help companies organize, harness, analyze, and understand radio frequency identification (RFID) data, as well as data from any other external or internal source. With technology from SAS, SAS solutions are built on a solid framework of data management and analytic technology that can scale to any size database, even those that contain massive amounts of RFID data.

SAS provides the industry's most powerful DATA INTEGRATION platform, which aggregates data from currently incompatible data silos on any platform and any format. An interactive interface makes it easy to manage ETL and data-integration processes to support RFID data requirements across the enterprise. Grid computing and a high-throughput, threaded architecture enable SAS data processes to efficiently process the massive volumes of data that RFID systems are expected to create. SAS provides an open, centralized, and integrated repository for managing metadata. Central management of metadata ensures that information is accurate and consistent, even though it might originate in and be shared among disparate systems within and outside of your organization. RFID data could significantly enhance the accuracy and value of your customer-relationship management (CRM), supplier-relationship management (SRM), and enterprise-resource planning (ERP) systems.



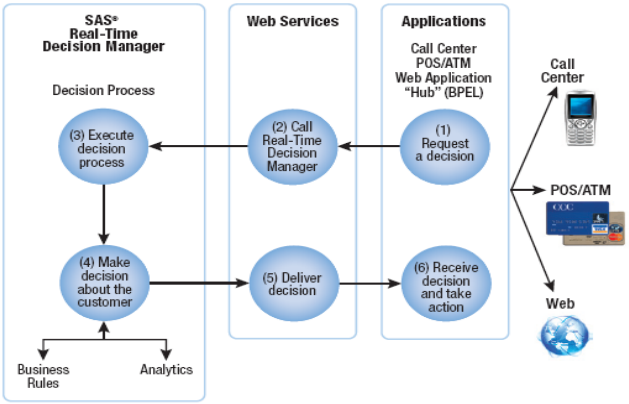
SAS® Retail Intelligence Solutions is RFID-compliant and can immediately handle all RFID data, from the supply chain to point-of-sale transactions. The four components of SAS Retail Intelligence Solutions are SAS® Customer Insight for Retail, SAS® Supply Chain Costing for Retail, SAS® Promotional Effectiveness for Retail, and SAS® Strategic Performance Management for Retail. These components build upon expertise in data management and predictive analytics through almost three decades of successful engagements with retail clients. Underlying the entire suite is the SAS® Retail Intelligence Architecture, an out-of-the-box, enterprise-wide data model that contains customer, retail outlet, supply-chain, and transaction information

down to the stock-keeping unit (SKU) level. By reducing implementation time and project risk, the unique architecture of SAS software speeds retailers' ROI.

SAS® REAL-TIME DECISION MANAGER

SAS® Real-Time Decision Manager allows organizations to enhance customers' experiences across inbound channels while controlling project costs and risks. The solution enables organizations to find superior ways to capitalize on customer interactions. By using innovative, interactive marketing tactics, organizations can realize significant gains in sales, retention, revenue, and profitability; and they can improve the overall customer experience.

SAS Real-Time Decision Manager enables organizations to maximize the value of individual customer interactions across all channels. The solution can provide intelligence for customer interactions at various touch points, such as the call center, Web applications, and point of sale (POS). SAS Real-Time Decision Manager can also integrate with business process management solutions that coordinate interaction with multiple systems. The decision can be made based on a 360-degree view of the customer that includes current interaction with the customer; historical data about the customer; and various analytical insights, such as predictive score, customer lifetime value, propensity, risk of attrition, and credit risk.



An overview of how SAS® Real-Time Decision Manager makes decisions about the customer at the moment of contact.

SAS® Real-Time Decision Manager is a key component of SAS® Customer Intelligence, which provides organizations with an integrated platform for enterprise-marketing management. SAS® Marketing Automation, another component of the SAS Customer Intelligence platform, provides intelligence for outbound channels such as e-mail, text messaging, and traditional mailings. The customer intelligence platform provides capabilities to coordinate communications between these channels.

SAS® Integrated Merchandise Planning solution includes integrated forecasting, easy access to relevant data, and support for any plan size. With automated planning and a merchandise-planning process designer, this solution provides intelligent recommendations and it removes variability from the planning

process. It uses standard KPIs to maintain consistent measurement between departments, categories, and locations. Integration with SAS Business Intelligence makes it easy to share performance information with the rest of the organization. SAS Integrated Merchandise Planning is based on one integrated platform for data management, analytics, and business intelligence, which keeps your total cost of ownership to a minimum.

SAS operational intelligence solutions optimize the entire gamut of retail operations, from making the right investments in real estate to managing the financial budgeting and reporting processes. With operational intelligence from SAS, retailers can determine the optimal site for a new store, automate the budgeting and reporting process, determine the right level of staffing to support store demand, and minimize losses arising from theft.

SAS performance management solutions for retail provide a consolidated, enterprise-wide view of the key metrics that drive the business. Retailers gain deep insights into their true profitability across the entire supply chain, optimize their relationships with vendors through aggregating and analyzing overall spending, and make smarter strategic decisions by incorporating predictive analytics into the strategic planning process. SAS performance management solutions can be used throughout key retail processes, from understanding and communicating with customers effectively to managing the integrated merchandising life cycle.

The Octopus card is a fare-collection system for Hong Kong's mass transit systems, convenience stores, supermarkets, fast-food shops, parking, and other point-of-sale applications. It has become one of the world's most successful electronic cash systems, with more than 13 million Octopus cards in circulation and about 300 service providers. Octopus now processes over 9 million transactions everyday. With over 1 terabyte of data and growing, there was enormous potential for discovering valuable patterns in the RFID data. SAS gave Octopus the capability to increase its business by gathering intelligence from its data and then marketing that intelligence to its retail customers through SAS advanced analytics, SAS BI and consulting, and SAS 9 Platform.

CONCLUSION

Many companies reluctantly accepted bar coding and electronic data interchange systems in the early 1970s because they were pressured into it by industry forces. Today, it would be hard to imagine doing business without the advantages of UPC codes and electronic commerce, which include speedier and more accurate merchandise tracking, faster store checkouts, supply-chain efficiencies, and insights about product movement.

RFID technology will not replace bar coding, but it holds even greater promise to improve operations and reduce costs for all parties.

There are data challenges, to be sure, but today's technology addresses those challenges in a way that brings real business benefit. With the right data-management and business-intelligence infrastructure to manage and use RFID data, this emerging technology could soon be as indispensable as, and more valued than, the humble bar codes that we now take for granted.

REFERENCES

Bhattacharya, Mithu, Chao-Hsien Chu, and Tracy Mullen. 2007. "RFID Implementation in Retail Industry: Current Status, Issues, and Challenges.", *accepted to Decision Science Institute (DSI) Conference, Phoenix AZ, for November 2007 conference.*

Chopra, Sunil, and Peter Meindl. 2004. *Supply Chain Management*. Upper Saddle River, NJ: Prentice Hall.

Disney, S.M., and Towill, D.R. 2003. "Bullwhip Reduction in Supply Chains: The Impact of VMI" *International Journal of Operations and Production Management*. Vol. 23: No. 6: 625-651.

Enarsson, Leif. 2006. *Future Logistics Challenges*. Frederiksberg, Denmark: Copenhagen Business School Press.

Garfinkel, Simson, and Beth Rosenberg. 2005. *RFID Applications, Security and Privacy*. Addison-Wesley Professional.

Gile, Keith. 2005. “RFID is Here – Has Anyone Seen the BI Vendors?” DM Review Magazine. August, 2005. Available at http://www.dmreview.com/issues/20050801/1033569-1.html.

Holweg, Matthias, Stephen Disney, Jan Holmström, and Johanna Småros. 2005. “Supply Chain Collaboration: Making Sense of the Strategy Continuum.” *European Management Journal*, Vol. 23, No. 2. 2005.

Howson, Cindi. 2007, “The Rise, Fall, and Return of Operational BI and Analytic Applications.” Available at http://www.intelligententerprise.com/blog/archives/2007/06/the_rise_fall_r.html

Hugos, Michael, and Chris Thomas. 2005. *Supply Chain Management in the Retail Industry*. Wiley.

Kampstra , R.P., J. Ashayeri, and J. Gattorna. 2006. *Realities of Supply Chain Collaboration*. Tilburg University, The Netherlands: Department of Econometrics and Operations Research; University of Wollongong, Australia: Centre for Supply Chain Research; and United Kingdom: Cranfield School of Management.

Lawson. “The Benefits of Vendor Managed Inventory” Available at http://www.lawson.com/wcw.nsf/pub/FB_A3F648

Levy, Michael, and Barton A. Weitz. 2006. *Retailing Management.* McGraw-Hill.

McKnight, William. 2007. “The Four Pillars of RFID.” *DM Review Magazine*. Available at http://www.dmreview.com/issues/20071001/1093510-1.html

Michael, K. , and L. McCathie. 2005. “The Pros and Cons of RFID in Supply Chain Management.” *Proceedings of the 2005 International Conference on Mobile Business.* Sydney, Australia. 623-629.

Microsoft Corporation. 2006. Microsoft White Paper. “The Business Value of RFID.”

Myerson, Judith M. 2006. *RFID in the Supply Chain: A Guide to Selection and Implementation*. Boca Raton, FL: Auerbach Publications.

NuThink, Inc. 2001. *Improve Profits, Competitiveness & Satisfaction with a high performance Retail Supply Chain.*

Simchi-Levi, David, Philip Kaminsky, and Edith Simchi-Levi. 1999. *Designing and Managing the Supply Chain*, McGraw-Hill.

So, Stuart C. K. 2006. “Securing RFID Applications: Issues, Methods, and Controls.” Information Systems Security. Available at http://www.allbusiness.com/professional-scientific/management-consulting-services/4087488-1.html ‘

VICS CPFR Advisory Team, 2004. ”Collaborative Planning, Forecasting, and Replenishment (CPFR®).” Voluntary Interindustry Commerce Standards (VICS).

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