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AUTO-ID CENTER

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Auto-ID in the Box: The Value of Auto-ID Technology in Retail Stores

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Hypermarket Retailer Reaches Hypergrowth with Auto-ID

CHICAGO – Le Marché seemed destined to be the perennial last place hypermarket until it began implementing Auto-ID technologies at various points in its store operations. Today, it has become the new rising star! How Le Marché was able to turn itself around is one of this year's retailing breakthrough stories.

Le Marché, a $10 billion hypermarket retailer, saw its problems mount in early 2000. When shipments arrived at some of its stores, the receiving process took too long, resulting in excess merchandise sitting in backrooms instead of on the shelf. During special promotions, store managers ran out of stock and had little knowledge of what was available at the distribution centers. And, at some locations, a number of good perishable items were being pulled from shelves because they were incorrectly grouped with products that were recorded with older expiration dates.

Auto-ID technologies have helped Le Marché turn it all around. "The level of information we now have is dramatically richer," said David Colbert, Vice President of Store Operations. "There's no comparison to what we had before. This knowledge is now our key competitive advantage."

Le Marché's inventory is now received more accurately and efficiently, merchandise levels are more easily monitored resulting in better-stocked shelves, expiration dates on products are more precisely captured and tracked, and fewer items are lost through shrinkage and theft. The company has been able to redirect its workforce from receiving and inventory tasks to more customer-facing activity.

Auto-ID technologies have clearly turned around many of Le Marché's store operations, and customers are responding favorably with their wallets.

Accenture Silent Commerce
www.accenture.com/SilentCommerce

Auto-ID technology has left the lab and is out in the real world, so it's not a matter of if, but when. Will you be ready to take advantage of the future scenario described above? Accenture has a vision for Auto-ID and broader related technologies, called Silent Commerce. Silent Commerce creates unlimited new business opportunities by making objects intelligent and interactive. It is "silent" because communication and commerce can take place between objects such as cases of paper towels, dock doors and warehouse management systems. For several years, we have been exploring the business potential of these innovative technologies at Accenture Technology Labs' Silent Commerce Centers located in Chicago, Illinois; Palo Alto, California; Sophia Antipolis, France and the Accenture Institute for Strategic Change in Cambridge, Massachusetts.

We have built working business applications and industry prototypes. We host hands-on workshops where companies can explore near- and long-term business and industry implications. This year in conjunction with the Auto-ID Center, we've collaborated with retail, consumer goods and freight transportation industry leaders to bring you a series of white papers focused on this exciting new value-creation opportunity. Auto-ID technology is an innovation that will revolutionize your business as you know it today. We invite you to explore the possibilities. Read on!

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Auto-ID in the Box: The Value of Auto-ID Technology in Retail Stores

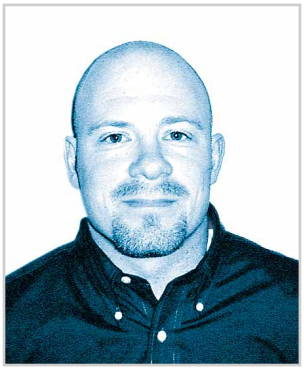
Biographies

Gavin Chappell
Partner

Gavin Chappell is a Partner in Accenture's Supply Chain Global Service Line. For more than 13 years, Gavin has specialized in developing and implementing solutions to drive improvements in Supply Chain operations, specializing in physical distribution and inventory management. He has worked extensively in the UK Retail sector and across Europe for both Retail and Consumer Goods companies. He is leading Accenture's Supply Chain practice in the adoption and implementation of Auto-ID solutions. Gavin has an Honors degree in Chemistry from the University of St. Andrews, Scotland.

David Durdan
Partner

David Durdan is a Partner in the North America Retail & Consumer Goods industry group of Accenture. He is one of the organization's leaders on Auto-ID, wireless and ubiquitous technologies. In this role, David is responsible for architecting and delivering technology solutions with a focus on immediate value delivery. During his 14-year career with Accenture, he has brought leading-edge technology strategies and solutions to companies worldwide. He has worked with Sears, Roebuck and Co., J. Sainsbury PLC, Benetton Group, Thomson Multimedia, Sears Canada, Sony Corporation, Shoppers Drug Mart and The Black & Decker Corporation. He is a frequent technology spokesperson as well as a guest lecturer at Northwestern University's M.B.A. program, and is quoted in a wide range of business and technology publications. David attended Queen's University in Kingston, Ontario, Canada where he studied Engineering Physics.



Greg Gilbert
Manager

Greg Gilbert is a Manager-Supply Chain Management in the North America Retail & Consumer industry group of Accenture. He specializes in applying Auto-ID technology solutions to the extended supply chains of retail companies, leading to improved performance and reduced costs. Since joining Accenture in 1996, Greg has spent the majority of his career focused on business process reengineering, software application implementations, supply chain planning and systems execution. Greg received a Bachelor of Arts degree from the University of Alabama and a Master of Business Administration from the University of Alabama Manderson Graduate School.

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Auto-ID in the Box: The Value of Auto-ID Technology in Retail Stores

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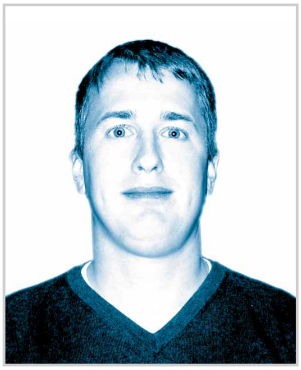
Lyle Ginsburg
Partner

Lyle Ginsburg is the Managing Partner for Technology Innovation in Accenture's global Products Operating Group. With more than 20 years' experience identifying new technology trends and bringing them to market, Lyle is now focused on finding the value of Silent Commerce for Accenture clients in the Retail, Consumer Goods, Transportation, Hospitality, Pharmaceuticals, Life Sciences, Automotive and Industrial industries. He has a Computer Science degree from Northern Illinois University.

Jeff Smith
Partner

Jeff Smith serves as the Managing Partner for Innovation in Accenture's Retail & Consumer Goods industry group. He is an internationally known specialist in technology innovation and Enterprise Resource Planning (ERP) solutions, speaking regularly to retail, manufacturer and other industry trade groups in the Americas, Europe and Asia. Over his 23-year career, Jeff has specialized in strategic planning, data modeling, design and development of value-creating technology solutions for large Retail and Consumer Goods companies, with a focus on customer/supplier collaboration processes and systems. Clients include Sara Lee, Meijer, Novartis Consumer Health, Nestle, Ahold USA and Wegmans. Jeff currently leads a research team assisting the Auto-ID Center in developing business cases for the commercial application of new Electronic Product Code™/radio frequency identification technologies (EPC™/RFID) in the consumer industries. Jeff holds a Master of Business Administration in Organizational Behavior/Informational Systems and an AB in Economics from the University of Michigan at Ann Arbor.



Joseph Tobolski
Senior Manager

Joseph Tobolski is a Senior Manager in Accenture Technology Labs. His main areas of expertise are Silent Commerce, Content Management, Collaboration and Knowledge Management and technical architectures. Joseph serves as the Director of Accenture's Silent Commerce Center, where he is investigating how emerging technologies such as RFID, sensors and actuators can enable inventory management, maintenance and logistics. Joseph received his Master of Science in Mechanical Engineering and his Bachelor of Science in Industrial Engineering from the University of Illinois at Urbana-Champaign.

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Auto-ID in the Box: The Value of Auto-ID Technology in Retail Stores

Contents

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Auto-ID in the Box: The Value of Auto-ID Technology in Retail Stores

Contents

1. EXECUTIVE SUMMARY

In the not-too-distant future, Auto-ID technology will help bring out the best aspects of the shopping experience and greatly diminish the things that customers don't like about shopping – resulting in more satisfied customers and ultimately, better bottom-line results.

Auto-ID technology will help free up valuable labor from in-store receiving, stocking, taking inventory and checkout for more direct customer support, as well as reduce product shrink and out-of-stocks. Additionally, retailers that face product obsolescence or spoilage will have better data to manage products nearing the end of their life cycle.

The biggest benefits include:

- Increased sales of up to 3 percent from improved store in-stocks
- Reduction in store labor expenses
  - Receiving – up to 65 percent
  - Stocking – up to 25 percent
  - Cycle Counting – up to 25 percent
  - Physical Counting – up to 100 percent
- Reduction in shrink equivalent of nearly 1 percent of sales
- Inventory write-offs from spoilage and obsolescence reduced by up to 20 percent

Although item level tagging and reading will return the greatest level of benefits, case and pallet tagging also provide significant returns. Higher margin categories such as apparel, consumer electronics, computers, media (such as CDs, software and books) and pharmaceuticals will likely be among the first to be tagged.

Based on our experience, we suggest the following steps to obtain the highest Auto-ID technology benefits in the shortest timeframe:

- Begin with an investment-grade business case to identify the highest potential value creating opportunities.
- Determine deployment models.
- Conduct pilots to test and refine deployment models.
- Scale deployment to obtain maximum benefits.

2. ACKNOWLEDGMENTS

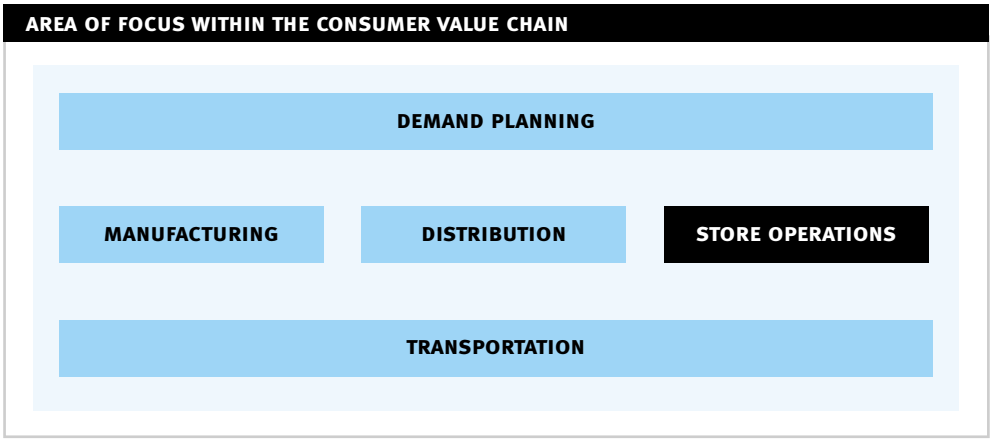
Accenture would like to acknowledge and thank the many companies, organizations and individuals whose insights proved invaluable to this paper, including the Auto-ID Center, Alien Technology, Best Buy, Checkpoint Systems, ConnecTerra, Display Edge Systems, Escort Memory Systems, Gemplus, Gillette, Graviton, Identec, Intel, Lyngsoe, Manhattan Associates, Matrics, Microsoft, Omron, Philip Morris, Philips Semiconductors, Procter & Gamble, RF Code, Rafsec, Red Prairie, Retek, SCS, SAMsys, SAP, Sara Lee Corporation, Savi Technologies, Sensormatic Electronics, Snyder Electronics, Symbol Technologies, Target Corporation, TEKsystems, Texas Instruments, The Home Depot, The Limited, Unilever, Wallace, Wal-Mart Stores and WhereNet.

3. INTRODUCTION

Working in close collaboration with the Auto-ID Center and its members, Accenture has developed this white paper to help companies in the retail sector determine the value of Auto-ID opportunities in store operations. Our findings are based on extensive research, business and operations modeling and financial analysis. This research includes in-depth interviews with Auto-ID board members, experts from Accenture's Supply Chain Service Line, Accenture practitioners in diverse vertical industry sectors and Accenture Technology Labs.

This paper includes all operations within a store such as receiving, checkout, loss prevention, returns and warranty. The paper also discusses the customer experience while shopping in the Auto-ID-enabled store.

Figure 1



A high-level application of Auto-ID across all functions and industries is discussed in the Accenture white paper, "Auto-ID Across the Value Chain: From Dramatic Potential to Greater Efficiency & Profit," by Ajit Kambil and Jeffrey D. Brooks. For additional in-depth analysis of the application of Auto-ID technology for retail, freight transportation, manufacturing and consumer goods companies, please see the following Accenture industry white papers, which are also available on the Auto-ID website:

- "Auto-ID on Delivery: The Value of Auto-ID Technology in the Retail Supply Chain"
- "Auto-ID on the Move: The Value of Auto-ID Technology in Freight Transportation"
- "Auto-ID on Demand: The Value of Auto-ID Technology in Consumer Goods Demand Planning"
- "Auto-ID on the Line: The Value of Auto-ID Technology in Manufacturing"
- "If You Build It, They Will Come: EPC™ Forum Market Sizing Analysis"

www.autoidcenter.org

A basic understanding of Auto-ID technologies is helpful in order to analyze the potential benefits and implications outlined in this white paper. An overview of Auto-ID technologies is included in the Appendix, Section 12. Additional information can be obtained from the Auto-ID Center website.

4. THE STORE ENVIRONMENT

The store environment is where the rubber meets the road for any retail company. Consumer perceptions and satisfaction levels are forged here by a variety of factors such as merchandise assortment and availability, checkout wait time, pricing and the amount of assistance they receive when they request help.

4.1. Operating in Today's World

A drug store retailer receives a shipment from a large direct store delivery (DSD) vendor. Since the vendor supplies several items across categories, there are many cases of different items on each pallet. Each case must be handled individually with the SKU number and item count being recorded manually.

An inventory control clerk notices an empty shelf location, although the store inventory system indicates that there are 12 units in the store. The clerk quickly checks the backroom without success and cycle counts the inventory to zero. The "missing" units are actually on an endcap at the end of a different aisle, but now the replenishment systems will reorder for units that are still in the system.

In an attempt to maintain accurate inventory, a big-box retailer must maintain a regular cycle count program, in addition to a yearly full physical inventory in every store. The cycle-counting processes cause as many issues as they solve, since items are often "lost" somewhere in the store. The physical inventory reestablishes the baseline, but store executives believe that within days, errors appear in the perpetual inventory system.

These situations are just a sampling of the issues and challenges that retailers face today. Labor-intensive processes, such as receiving and stocking, reduce the amount of time that store associates could spend assisting customers. Excess inventory for slower-selling items leads to higher operating costs, while out-of-stocks on faster-moving and promotional items reduce consumers' satisfaction with the shopping experience.

4.2. The Shopper's Point of View

Shopper Frustration #1
You're meeting neighbors for dinner but you're running late at work. It's your responsibility to bring wine. You rush to the store, grab what you need and proceed to wait in a long line at the only open checkout.

Shopper Frustration #2
You've been keeping your eye on that flat-screen TV for months. Finally, you spot an ad that shows it's on sale this week. You head over to the store the first chance you get, only to discover the TVs are all out of stock. To add to your frustration, no one knows when the item is expected to be in stock again.

Shopper Frustration #3
You've been eyeing a special item as a gift for several weeks, but when you go to the store to buy it, they are sold out. The store clerk does not know when more will be in stock since he does not have visibility to incoming shipments. He asks you to check back on Wednesday, since they receive shipments on Tuesday. You dutifully return to the store, only to find that your special item, of course, isn't there. This story repeats itself for two more weeks before you give up.

Sound familiar? Every day consumers endure the hassles of shopping. Their frustrations are well known. According to **Shopper Report**,[1] consumer network panelists said that price accuracy, efficient checkout and special promotion item availability were more important than good everyday prices or sales and specials. Although most retailers know about these issues and are attempting to deal with them, consumers still want more. Fortunately, for retailers, some promising break-through solutions are on the horizon.

[1] The three most important measures of customer satisfaction are:
1) price accuracy,
2) efficient checkout and
3) item availability.
Shopper Report, March 2002.

5. AUTO-ID: IMPROVING EFFICIENCY AND INVENTORY ACCURACY

Store operations in the future will change noticeably as Auto-ID technology improves labor processes, inventory position, product freshness, shrink/theft and returns/recalls. While the use of Auto-ID tags and readers in these areas is just emerging, they hold much potential for markedly improved operational and financial results.

5.1. Product Receiving

Direct Store Delivery (DSD) and Distribution Center (DC) Product
Receiving product correctly at the retail store can be a labor-intensive process, especially for shipments that arrive directly from the vendor. Many retailers must allocate a significant portion of the store labor budget to this process versus serving customers. When discrepancies arise between purchase order quantities and received quantities, even more labor must be expended.

Many retailers perform an "assumed receipt" function for merchandise arriving from one of their own distribution centers. In this process, the store associate "assumes" all the items that were supposed to be shipped actually were shipped and the store inventory is updated once the shipment is acknowledged. While this process reduces the amount of labor required to receive the product, it also allows for concealed shipment shortages to go unnoticed and therefore create inaccuracies in the store inventory systems. By overstating the inventory in this manner, the store replenishment systems may never replenish the correct amount to the store.

Units tagged with Auto-ID tags and reader portals at store receiving doors will enable faster and more accurate receiving. As tagged pallets, cases and items are brought through the Auto-ID portals, the Auto-ID readers will record the shipment. This data will be communicated to the store inventory systems, where inventory is accurately updated.

The benefits of the improved receiving process are reduced labor required for receiving as well as reduced vendor and paperwork shrink. Another benefit of this process is that correct receipt quantities become the basis for accurate store-level inventories, creating the foundation for maintaining a solid store in-stock level.

5.2. Maintaining Shelf Stock

Ensuring that customers can find the items they are looking for is no small challenge for retailers. Inventory availability remains one of the hottest issues for consumers. In a study conducted by Accenture[2], it was estimated that 33 percent of out-of-stock items are located in the store, just not in the correct location.

[2] "Where to Look for Incremental Sales Gains: The Retail Problem of Out-of-Stock Merchandise – A Study Conducted by Accenture for the Coca-Cola Retailing Research Council," Accenture, January 16,1996.

Inaccurate store inventory levels are one cause of true out-of-stocks. Store ordering and replenishment systems rely on this information to generate shipments for the store. Receipts, sales data and cycle or physical counting are typically the only updates for store inventory systems. These all rely on manual processes and are therefore prone to some level of error. Additionally, atypical product movement such as shoplifting or employee theft will not be captured until the next cycle or physical count.

Lack of timely inventory information is another cause of true out-of-stocks. Due to the limitations of many point-of-sale (POS) systems in use today, many retailers are not able to capture sales data until the end of the day. For most items, this is sufficient, but for faster-moving items, this delay may result in the store selling through its entire supply prior to the next shipment of the item.

There are several other causes for in-store out-of-stocks, such as:

- Consumers picking up products and then putting them down in another location, where they are "lost" until a store associate locates and re-shelves the product.
- Associates not stocking or storing products in the correct location.
- Selling through the entire display quantity before store associates can identify the trend and restock the location.
- "Losing" product in the backroom or other storage areas only to find it again later, once more product has been ordered.

Retail shelves equipped with Auto-ID readers and antennae will be able to monitor the location of all tagged merchandise and update store inventory systems dynamically. When the display stock for an item falls below a pre-configured amount, the system can send a message to an employee carrying a wireless device alerting her that she needs to re-supply the selling location from the backroom. Since the backroom is also wired with Auto-ID technology, she will know exactly where in the backroom to retrieve the product. Employees will no longer have to "scout" the store looking for empty locations to fill.

Employing mobile stocking carts (or other similar devices) equipped with Auto-ID technology can reduce stocking errors. When the store associate places a carton or tote of product on the cart, the readers will sense the items on the cart and direct the associate to the correct stocking locations. While the associate is in the aisle, he can be instructed as to where other products are misplaced and where they should be restocked.

5.3. Maintaining Product Freshness

Product freshness is a major concern for grocers and for many stores selling prescription and over-the-counter (OTC) drugs. A common problem occurs at the distribution center when an entire pallet of product is updated with an incorrect date simply because it is grouped with another pallet of newer product and the same date is recorded for both pallets. Eliminating these errors at the distribution center would enable stores to operate with much more accurate data.

Auto-ID technology will significantly reduce the human and paperwork errors that currently misrepresent a product's shelf life. While Auto-ID technology cannot by itself extend a product's life, it can provide much more accurate data about its current state. Retailers can then make more informed decisions about how to handle those items reaching the end of their life cycle.

5.4. Reducing Checkout Labor

Checkout labor as a percent of overall store labor varies greatly by category. Mass merchants, grocers and drug stores have relatively high labor expenditures for checkout, while specialty apparel and higher-end department stores typically have lower ratios for this function.

Checkout is also a source of great frustration for consumers. The results of one survey report that 72 percent of respondents rated checkout efficiency as very important[3]. Another survey [4] calculated that average total time spent at supermarket checkout is five minutes and 34 seconds. Three minutes – more than half of that time – is spent waiting.

[3] Almost 75% of shoppers rated checkout efficiency as very important for their satisfaction according to S**hopper Report**, March 2001.

[4] Average wait time at the checkout is 5 minutes and 34 seconds according to an internal study commissioned by Time Distribution Studies and conducted by Envirosell in 1999.

Auto-ID technology can reduce wait times and store labor in several ways, such as reducing the amount of time associates spend scanning, mis-scans, or no scans due to the inability to locate the barcodes or barcode damage. With Auto-ID technology, all the consumer must do is place the items on the counter or on the belt, and the readers will read the EPC™ information and generate the sale total.

Auto-ID may increase the acceptance of self-check stations. While Auto-ID is not required for self-checkout, the increased read rate and the potential for being able to instantaneously read every item in a customer's basket, may make self-checkout more attractive.

5.5. Shrink/Theft

Shrink averages 1.69 percent of sales for retailers.[5] While attaching a device to an item to address shrink is not a new idea, the current focus is on alerting store personnel as an item is being removed from the store. Auto-ID will provide the same capability, in addition to identifying suspicious behavior while still at the shelf (e.g., the simultaneous removal of five CDs of the same title). Higher-value goods might warrant automatic notification of store security, along with adjusting surveillance cameras to the area where the action is occurring. Retailers will now have access to data about what items have actually left the store, and potentially how they left. This information can be used to strengthen and better focus loss prevention measures.

[5] Shrink represents 1.69% of sales for retailers, "2000 Retail Survey Report," University of Florida, 2000.

Return fraud is another area of store shrink that is difficult to track accurately. For example, a fraudulent customer may remove an item from the store shelf, then go to the customer service desk and attempt to return it for store credit. With an EPC™ tag, the purchase history of that exact item is known, and the store systems will be able to identify where and when the item was purchased, if purchased at all.

5.6. Returns/Warranty Authentication

A recent television commercial for a large U.S. electronics retailer satirizes a consumer attempting to return a purchased item without a receipt. As the customer is searching in his wallet for the receipt, the store associate keeps trying to tell him that the receipt is not needed since they store all the information needed in the store's computers. In today's world, consumers must provide their name, address, phone number and other personal information to enable this transaction. Many retailers do not attempt this functionality and instead, restrict their return and exchange policies to protect themselves from undue loss.

In the Auto-ID-enabled world, all retailers will be able to deliver this capability without first interrogating their customers. Item-level history will allow the associates to know when (if) the item was sold, the selling location and the exact selling price, even if the consumer paid with cash and did not identify himself to the store in any way. This data will reduce the number of invalid returns and enable faster, less intrusive and more complete customer service. It will also reduce consumer frustration with the returns process.

The same information that is stored about an item's purchase date can also be used to authenticate warranty claims since the exact date and location of the sale can be determined. This would allow manufacturers and retailers to offer staged warranties: when a product fails early in its life cycle, a full replacement might be in order, but if it fails later in the life cycle, then perhaps only half of the replacement cost is covered.

5.7. Recalls

While product recalls may not be a common occurrence for store operators, when they do occur they are costly and difficult to execute. Today, the only way to guarantee that all recalled product is removed from the store is to pull every item of that SKU from the shelves. This costs the store operator added expense in labor and removes some satisfactory product from the shelves, reducing further potential sales opportunity.

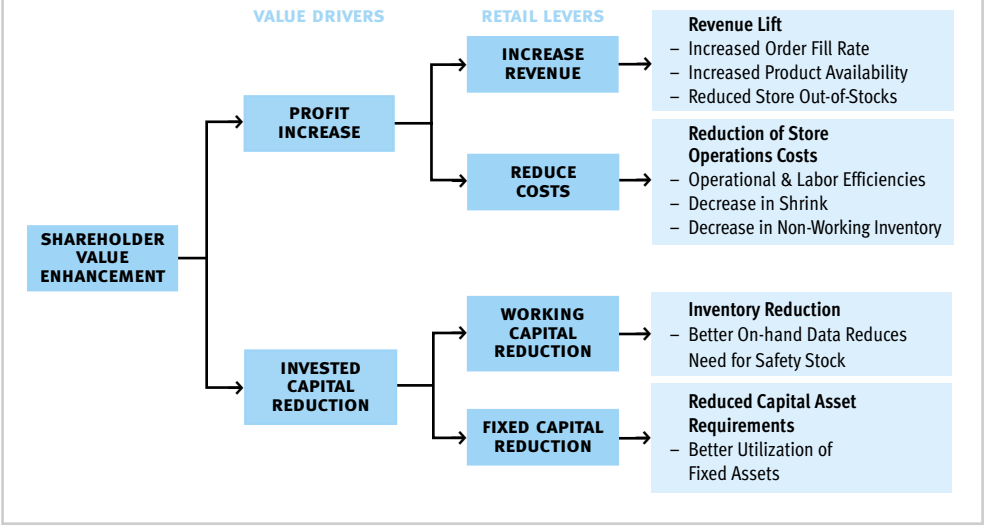
With Auto-ID technology, the manufacturing lot number of every item can be tracked. This will arm retailers with the information needed to pull only the defective or spoiled product from the shelves, leaving the remaining product intact and ready for sale.

6. BENEFITS SUMMARY – THE VALUE LEVERS OF AUTO-ID

The shareholder value tree below (Figure 2) illustrates the many variables that impact the bottom line for retailers. At the most basic level, companies must either increase profit or decrease invested capital to improve value. The variables to the far right are the retail levers that can be altered to improve overall financial performance.

Figure 2

RETAIL SHAREHOLDER VALUE TREE



Accenture's research on the impact of Auto-ID technology in store operations has concluded that there are four principle areas of benefit that will apply to most retailers: reducing in-store out-of-stocks, labor reduction, decreased shrink and decreased inventory write-offs.

6.1. Reducing Out-of-Stocks

For one retailer, Approximately 40% of consumers leave the store without asking for assistance if they cannot locate an item.

The issue of in-store out-of-stocks plagues many retailers in today's world, and is compounded by increasing store size and SKU proliferation. One store executive stated in a recent internal store exit survey that 40 percent of their consumers, not finding what they are looking for, leave the store without asking an associate for assistance. In a recent pilot, The Gap[6] found it could increase in-store item availability to almost 100 percent by applying Auto-ID tags and tracking inventory in the stores. This degree of in-stock availability holds enormous potential. For a retailer with a 70 percent conversion rate, assuming that 10 percent of consumers leave due to not finding the item they were looking for, the benefit would be equivalent to a 3 percent increase in sales.

6 "The Gap Tests RFID Smart Label Technology for Tracking Denim Clothing From the Factory to The Store", Texas Instruments press release, November 13, 2001.

6.2. Decreasing Labor Expense

Store labor is a big expense for most retailers. Auto-ID technology has the potential to increase the efficiency of most daily tasks such as receiving, stocking, product locating and checkout, along with periodic tasks such as physical and cycle counting. Although the potential labor savings varies greatly by type of retailer and category, the savings are still significant:

Table 1: Per Function Potential Store Labor Reductions with Auto-ID

CATEGORY	PERCENT REDUCTION
RECEIVING	50 – 65%
STOCKING	22 – 30%
CHECKOUT	5 – 45%
CYCLE COUNTING	40 – 60%
PHYSICAL COUNTING	90 – 100%

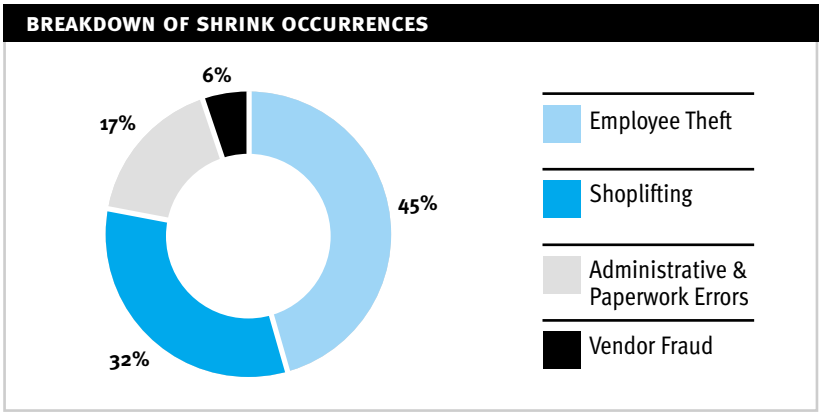
Many retailers have stated that as opposed to reducing their overall store labor hours, the hours would be redirected to improving customer service and assisting customers in the store. Although difficult to estimate, this would undoubtedly lead to an increase in customer satisfaction and an increase in sales.

6.3. Reducing Shrink

The degree of shrink varies significantly by category, ranging from 2.82 percent in toys and hobbies to .62 percent in computers and consumer electronics.[7] Cause of shrink occurrences is shown in Figure 3.

7 "2000 Retail Survey Report," University of Florida, 2000.

Figure 3



It is safe to assume that 100 percent of shoplifting, roughly 60 percent of employee theft and 30 percent of administrative and paperwork errors occur in the stores. The amount of vendor fraud that occurs in the store will be proportional to the amount of product shipped directly to the stores.

Assuming 100 percent tagging compliance, the reduction of vendor fraud at the store can approach 100 percent, along with 80 percent of paperwork and administrative errors. Shoplifting and employee theft has the potential to be reduced by 50 percent. Accenture's research indicates that the cumulative effect of these activities results in a reduction of shrink from the industry average of 1.69 percent of sales to approximately .78 percent.

6.4. Reducing Inventory Write-offs

Write-offs occur for three simple reasons: 1) the product in question is no longer fit for consumption, 2) consumers no longer desire it, or 3) it is damaged while in the retailer's possession. The root cause for the first reason is spoilage, caused by time or temperature exposure, and applies to many products in the grocery vertical as well as some types of prescription medications. Lack of desirability can be caused by obsolescence in the case of consumer electronics, or seasonality in the case of apparel, sporting goods, media and several other categories.

Accenture's research has determined that with Auto-ID, the cost of inventory write-offs can be reduced by as much as 20 percent for some categories.

7. BUSINESS CASE SCENARIO

Cornucopia is a large hypermarket retailer. Since it opened, it has seen several years of significant sales growth. This growth was the result of increasing the item assortment to appeal to a broader range of consumers. To accommodate the larger assortment in the same space, the selling space per item has been reduced on all but the fastest-moving items. The store backroom space has also been reduced, meaning that storage shelves are higher and harder to search through. To keep inventory carrying cost low, a replenishment system automatically generates the orders for the stores on a regular cycle.

This growth has not been without its pains. Cornucopia's store inventory systems that track most of the company's inventory are seldom accurate. Periodic cycle counts and yearly physical counts always reveal significant errors. Due to these inaccuracies, Cornucopia often has more merchandise than is needed for slower-moving items and never seems to have enough of their fast sellers.

Since the current distribution network could not handle all of the additional volume, more merchandise has been shifted from DC delivery to DSD, causing a dramatic increase in the amount of labor required to receive the product. Yet, most of the store managers still do not feel they have accurately received most shipments.

To address these issues, Cornucopia began researching potential solutions using Auto-ID technology. The company found that by implementing the technology, it could move product to the sales floor much faster than it could have ever done with barcodes. Auto-ID allowed the company to streamline the receiving process and provided knowledge of what was needed to go to the floor and what could be stored in the backroom. To further increase product availability, Cornucopia installed Auto-ID readers on shelves and configured them to alert store associates when inventory levels were low. Cornucopia was also able to reduce shrink by identifying trends and implementing measures against it.

To determine the projected total benefit for Cornucopia, the following business case has been developed.

Table 2: Cornucopia Parameters for Business Case

PARAMETERS	
Sales Dollars	$ 20,000,000,000
Average Selling Price	$ 15
Average Unit Cost	$ 9
Store Labor as Percent of Sales	5%
Number of Stores	750
% Product Shipped DSD	35%
Shrink as a % of Sales	1.45%
Inventory Write-offs as a % of Sales	0.25%
Sales Conversion Rate	75%

Applying these values to Accenture's Silent Commerce Cost/Benefit Calculator, the projected benefits are as follows for case- and item-level tagging implemented across all stores on an annual basis:

Table 3: Projected Benefit Summary for Cornucopia Store Operations

BENEFIT CATEGORY	CASE LEVEL ($)	ITEM LEVEL ($)
INCREASED SALES THROUGH BETTER IN-STOCKS	60,000,000	200,000,000
DECREASED LABOR EXPENSE	141,275,000	218,900,000
DECREASED SHRINK	42,267,500	157,180,000
REDUCED INVENTORY WRITE-OFFS	2,820,000	6,000,000
TOTAL ANNUAL BENEFIT	**246,362,500**	**582,080,000**

The final aspect of the business case is developed with the technology configurator contained within the Accenture Silent Commerce Cost/Benefit Calculator. These costs are developed using three distinct store formats and fixture arrangements and represent the total cost for implementing the technology throughout the entire chain. The average cost per store is also calculated.

Table 4: Total Cornucopia Technology Costs

COST CATEGORY	CASE INFRASTRUCTURE UP-FRONT COSTS ($)	ITEM INFRASTRUCTURE UP-FRONT COSTS ($)
READER COST	16,900,000	133,000,000
COMPUTERS	952,000	7,500,000
STORAGE COSTS	726,000	5,722,000
DATA MANAGEMENT SOFTWARE	1,900,000	15,000,000
INFRASTRUCTURE INSTALLATION	2,200,000	16,600,000
SYSTEMS INTEGRATION	3,600,000	28,200,000
TOTAL	**26,200,000**	**203,400,000**
AVERAGE STORE COSTS	34,920	$ 271,245
ANNUAL MAINTENANCE COSTS		
SERVICE/REPLACEMENT	1,700,000	13,000,000
AVERAGE	2,250	17,380

Cornucopia phased in the rollout over the course of three years with 25 stores implemented in the first year, 150 stores the second year and the remaining stores the following year, with an internal rate of return of 8 percent. **The projected five-year Net Present Value (NPV) for both the case- and item-level solutions was positive, with the case-level solution presenting a projected positive cash flow in the second year and the item-level solution resulting in projected positive cash flow in the fourth year.**

8. SHOPPER'S DELIGHT

No discussion about the impact of Auto-ID in retail stores is complete without at least some discussion of the consumer's reaction. Many of the benefits described up to this point have a direct impact on the frustration for today's consumer as described in Section 4.2. Let's revisit those scenarios to determine how they might differ after the implementation of Auto-ID technology.

Shopper Delight #1
You're meeting neighbors for dinner, but running late at work. It's your responsibility to bring wine. You rush to the store, grab what you need and head to the checkout. Since you have an RFID payment device linked to your payment preference, you are able to pass the wine and your key chain past the checkout station reader, grab your receipt and head to dinner.

Shopper Delight #2
You've been keeping your eye on that flat-screen TV for months. Finally, you spot an ad that shows it's on sale this week. You head over to the store the first chance you get to discover the TVs are all out of stock. However, the department manager informs you that several are due to arrive from the vendor any time now. He mentions the TVs sold much faster than expected, but since the store was able to monitor the inventory in real-time, it was able to place an order with the vendor to meet demand. You give the manager your phone number so he can let you know when they have arrived. He calls you that night to let you know the TVs came in and he has one reserved for you.

Shopper Delight #3
You've been looking at a special item as a gift for several weeks, but when you go back to the store, you can't find the item. You ask a clerk who checks in the real-time inventory system and informs you that there is one remaining item but it is located on a different shelf. He apologizes for the inconvenience, walks you over to the other display and you are able to leave the store with the perfect gift.

9. THE ADOPTION PATH

Category does matter, at least when it comes to Auto-ID benefits and likely adoption scenarios.
The primary criterion determining early adopter categories are shrink, price point, margin, obsolescence and spoilage. Each of these factors increases the need for accurate, real-time (or near real-time) data. These value levers and why they are important are described below.

9.1. High-Value Items

Value can be defined as either margin or price point. The most likely targets for Auto-ID tags in the near term are those that have either a high margin or a high price. A retailer faces a large opportunity cost by not having the right product available at the right time, making it easier for a retailer to absorb the cost

of the tag. Customers who don't find the items they are searching for invariably leave the store empty-handed, resulting in lost sales and reduced inventory productivity. When this happens with high-value, high-margin merchandise, the opportunity cost to the retailer is significant.

9.2. High-Loss Items

Items that are currently tagged with other loss-prevention devices are especially good candidates for tagging with Auto-ID tags since the retailer/manufacturer is already absorbing the cost of the other technology. This can serve as an entry into Auto-ID technology and facilitate the installation of in-store Auto-ID capabilities. Once the financial benefits of the reduced shrink have been realized, investment into other application areas can be undertaken with reduced effort since the underlying infrastructure will already be in place.

9.3. High-Obsolescence Items

Items that have a limited selling life span are at risk of obsolescence. Obsolescence exposes retailers to the risk of having products in their stores that consumers no longer wish to purchase. To reduce the risk, most retailers maintain lower inventories on these items. Managing the inventory quantities of these products as they reach the end of their selling life is critical to avoid high markdowns and write-offs of unsaleables.

9.4. High-Spoilage Items

Items that have an expiration or "sell by" date are at risk for spoilage. Spoilage, like obsolescence, causes retailers to mark down items that are nearing the end of their shelf lives or to write off inventory that has passed the expiration date. Packaged foods can be monitored with Auto-ID technology to ensure that items nearing the end of their selling life are brought to the attention of store managers. Unpackaged foods may never be tagged.

10. CONCLUSION

Based on our research and field experience, we believe there are benefits to be obtained from the use of Auto-ID technology regardless of category, although category-specific economics will determine the rate of adoption.

The increased visibility to inventory within the store environment and throughout the entire value chain creates the potential for retailers to:

- Increase sales by increasing the availability of inventory.
- Reduce shrink by identifying trends as they occur.
- Reduce capital charges caused by inventory write-offs.
- Facilitate a more efficient and effective returns process.

The increased read rate of Auto-ID will allow retailers to streamline operations, resulting in:

- Reduced labor requirements for receiving, stocking, locating inventory, conducting inventories and checkout.
- Reduce consumer wait times at checkouts.

While the end goal for Auto-ID is to enable item-level tracking, retailers choosing to implement case-level tagging in the near term can realize significant benefits. The benefits gained from the case-level applications can pave the way for item-level adoption as the costs of Auto-ID technology decline.

11. NEXT STEPS

11.1. Value Targeting/Business Case Development

Using the levers Accenture has identified in Section 6 of this paper, retailers should evaluate every potential application. This step will require detailed financial and process analysis, as well as the development of a functional process/business model, using multiple inputs to generate a high-level business case. Once the highest benefit areas are determined, the next step is to build these benefits into a time-phased model that will also allow the implementation costs to be considered. The result of this model will provide the retailer with the financial metrics required to determine high-value implementation areas, such as Return on Investment (ROI), Net Present Value (NPV) and Economic Value Add (EVA).

11.2. Pilots/Proof-of-Concept

The results from the first phase will lead to detailed pilots that serve as the proof-of-concept for the application of Auto-ID in the specific retailing environment. In the supply chain, this pilot might consist of processing a single vendor's products through a single Auto-ID-enabled distribution center, with processing points in both the inbound and outbound segments having Auto-ID capabilities as well.

Pilots serve two purposes: 1) to validate the business cases and 2) to prepare the retailer for full-scale implementation and integration. A rigorous business case, validated by thorough piloting, will position retailers for Auto-ID integration at scale as well as open system collaboration with trading partners across the extended value chain once Auto-ID standards are in place.

11.3. Implementation

If the pilots are successful in realizing the projected benefits, the next step is to develop a detailed, time-phased rollout plan in conjunction with key suppliers and third-party transportation providers. Without the cooperation of these trading entities, the full scale of benefits will never be achieved.

11.4. Managing the Unknown

While it is clear that Auto-ID applications will unlock unprecedented value in the future, the path to adoption and implementation will be a challenging one. Although many companies have implemented point solutions using Auto-ID technology, the scope and scale of the EPC™ revolution coupled with item-level tagging are unprecedented. All the obstacles along the path to widespread Auto-ID adoption are unknown, but some of the known challenges are data storage requirements, network bandwidth and the accuracy of read rates. These issues will likely force adoption of case-level tagging applications, with a gradual transition to item-level tagging as issues are resolved. Managing this implementation process will require detailed planning and a deep familiarity with the industry.

12. APPENDIX

12.1. Auto-ID Primer

Introduction

Auto-ID technology consists of several parts: eTag – an electronic tag, Electronic Product Code™ (EPC™) – a unique identifier, Object Name Service (ONS), Savant™ Systems and Physical Markup Language (PML). By embedding the Electronic Product Code™ into products, intelligent and communicative objects result. This creates what Accenture refers to as a Virtual Double, where for every physical object there is an analogous data representation. In this sense, atoms and bits are aligned.

The Electronic Product Code™

The first component of Auto-ID technology is the EPC™. It is a string of numbers that provides a unique identification. For instance, instead of referring to a class of products (as Universal Product Codes do), the EPC™ refers to a specific instance of a product (see Figure 4).

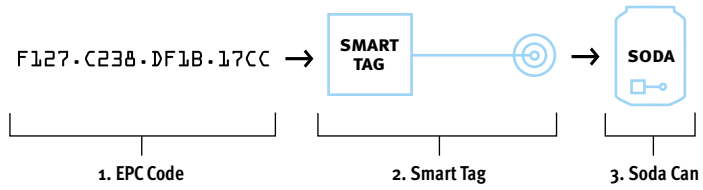
Figure 4:

1. EPC™ Code
Unique Number 96 bits long

2. Smart Tag
Made from a microchip with antenna – transmits EPC™ code

3. Soda Can
Typical Object becomes unique because of "Smart Tag"

INTRODUCTION TO AUTO-ID



To enable Auto-ID, the EPC™ is embedded in a memory chip contained within a smart tag on individual products. The chip is mated to an antenna. This allows for the smart tag to be scanned by a radio frequency "reader," which transmits the product's embedded identity code to a network, where the "real" information on the product is kept. That information is then communicated back from the network to provide whatever information is needed about that product. RFID is the basis for current Auto-ID technology. It is important to note that the baseline functionality of these tags provides read-only access to the EPC™. No information need be kept on the tag.

The Auto-ID Center standard does not preclude other tags with read-write functionality or even more advanced capabilities. However, as additional functions and capabilities increase, so will tag cost. Read-write tags also tend to be slower as well as shorter range than their read-only counterparts. Additionally, implementation of EPC™ does not depend on RFID technology; any way of being able to quickly and easily read a unique ID from a product will work. RFID is the most likely option today, but technologies not yet commercialized (such as amorphous metal threads or ultra-wide band) may also play a part (see Figure 5).

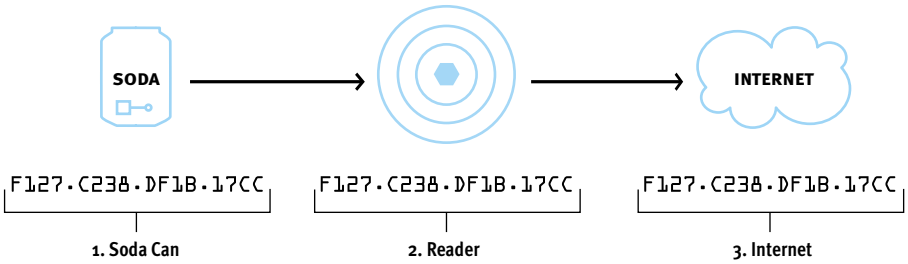
Figure 5:

1. Soda Can
Transmits EPC™ Code from embedded "Smart Tag" on side of can

2. Reader
Could be found in shelving, appliances, etc. Transmits EPC™ to Internet

3. Internet
Uses EPC™ to access unique object information

TRANSMITTING EPC™ CODE



The Object Name Service

The next step in the Auto-ID chain is the Object Name Service (ONS). The ONS tells computer systems where to find information about any object that carries an EPC™. ONS is based in part on the Internet's existing Domain Name System (DNS), which routes information to appropriate network interfaces. The ONS will likely be many times larger than the DNS, serving as a lightning fast "post office" that locates data for trillions of objects carrying an EPC™.

The Physical Markup Language

Physical Markup Language (PML) is a new standard "language" for describing physical objects in the same way that Hypertext Markup Language (HTML) is the common language on which most Internet Web pages are based. Almost anything can be contained within the PML description of an object: its physical characteristics such as weight or caloric content, repair instructions and audit trails. PML will allow for manufacturers to specify and customize the information tracked on products. There will not be a vast repository of PML descriptions. Ultimate implementation of the PML descriptions will result in highly distributed data. Manufacturers, retailers and consumers will all have unique views to data. One probable outcome of Auto-ID technology is that in the same sense that product is shipped, so will access to information or the information itself.

Applications

Auto-ID applications are numerous. They include manufacturing process control (flexible manufacturing, outsourcing), inventory management (retail stocking, spare parts, and back-room supplies), supply chain optimization (distribution center operations, transportation, ordering and replenishment), regulatory compliance (customs, security, tariffs), recall management and recycling.

In all these areas, Auto-ID offers the potential for significant savings, as well as new sources of incremental revenue. New services will start to emerge as objects start to become smart and interactive. As the technology becomes pervasive, benefits will extend throughout the entire value chain.

Auto-ID technology has the capability to redefine the global marketplace by embedding intelligence, identity and Internet connectivity into everyday objects. The EPC™ unites elements of the entire supply chain, making it an interactive, dynamic cycle from raw material and distribution to point-of-purchase and recycling, and back to raw material. Products equipped with smart tags will interact with manufacturers, their trading partners and each other to form an optimally efficient cycle of direct, real-time supply and demand.

12.2. Challenges

As with any revolutionary technology, there will be challenges to overcome in Auto-ID implementation. Some challenges are technological in nature, some economic, and some societal. The following topics outline these challenges and seek to address how to overcome them.

Accuracy
Readers cannot be guaranteed to be able to communicate with all tags in a volume 100 percent of the time. Environmental issues, the makeup of the products being tagged and the volumes of tags to be read all impact read accuracies. Nothing is foolproof. The degree of concern is proportional to how much an enterprise relies on absolute data.

RFID offers many advantages over manual or semi-automated data collection processes. Any shortcomings in accuracy can be mitigated through the use of redundant readers, information auditing and process redesign. If tagging at the pallet and/or case level, fewer tags will need to be read and accuracy will increase.

Interference
As readers proliferate, more occurrences of interference will be documented. Depending on the frequencies and powers used, devices such as phones, wireless handsets and industrial equipment may be affected. Since such a widespread penetration of RF technology has not been undertaken before, it is difficult to state explicitly what will be impacted. Good engineering and proper tuning will be important in overcoming this challenge.

The perceived health risks of this much RF may also come into play. While there is no evidence that there are any negative effects at the power and frequency levels associated with RFID, no one has rolled out such large-scale implementations yet. More research and monitoring will need to be conducted to address the public's concerns in this matter.

Performance
Smart objects will generate tremendous amounts of data. This much data will not be accessible if stored in a massive central repository, so some distributed data will be necessary. How will this distributed data be managed? Will it be accessible? How will it be accessed? The Auto-ID standard calls for read-only tags with a unique identifier. However, it is not hard to see mission critical applications where this is not a viable option. For instance, in field service, remote locations, or even on airport ground areas, speed of network access cannot be guaranteed, and it will be much more convenient to have data on the tag.

Speed of information access is important. Subsecond lookup times will be expected in many applications. Where data is kept, as well as the networking infrastructure and computing platform, will greatly influence this speed. Simply put, for EPCs‰ to work, the data associated with a given EPC™ must be available on demand.

Frequency Availability
Since RFID uses unlicensed RF spectrum, the available spectra that is usable for RFID is an issue. Although there are some frequencies that are common, there is no universal standard. 13.56 MHz and 2.45 GHz are both worldwide standard ISM frequencies. These are available in most parts of the world, albeit at slightly different restrictions. However, more useful in terms of read range and speeds are tags operating at roughly 915 MHz or ultra-high frequency (UHF). The UHF spectrum around 900 MHz is not universally available at the same frequency and power levels worldwide.

This will be addressed through two potential methods. The first alternative is multi-frequency readers. Overall RF system design (integration of antenna, readers and tags) is the most difficult part of the problem. The second is to select a common frequency. Obviously, since this involves millions of stakeholders, the lead time on this will be considerable. This does not, however, deal with the fact that not all frequencies work well for every application (although some work well across virtually all applications).

Security

Security is paramount, and contains many levels. There is read security (or being able to read the tag), security of the data, and many other security issues. For users of the technology to feel comfortable, there will need to be assurances that no one will be able to "hack" into a smart object. As long as tags are read-only and are difficult to counterfeit, then security will be somewhat a given. Users of Auto-ID technology will also need to rely on the security of Auto-ID data on the network.

Data Ownership

Related to security, data ownership is an issue. Who "owns" the massive amounts of event information associated with an object? It is clear that the manufacturer owns the design specs and other PML type data for a given product. It is clear who owns captured data – the owner of the reader that reads the tag. It is less clear, however, how information will be shared.

Many parties will be privy to and will update the data for an object as it passes though a supply chain. Will those collecting the data even want to share data (consider a shipper with less than stellar turn-around times – would they be interested in sharing item-level tracking information?). Does an end-user (consumer) ultimately "own" a product and its data, and if so, how does use of that data for process improvement or data mining impact privacy?

Lastly, although killing a tag when purchased has been discussed as an option, this method eliminates future recycling benefits, and also introduces the potential of tags being killed maliciously or by accident, before they should be.

Privacy

Finally, a large, mostly perceived risk in Auto-ID, falls within the area of privacy concerns. The idea of tracking products into the home is troubling to most concerned parties. Consumer fears in this area are sparked by a lack of understanding of the limitations of RFID. Education is the key here – as people learn about when and how the technology works and what exactly is stored on the tag, the privacy concerns may lessen. Also, as consumers see value in the technology, acceptance will increase. For instance, consider stored warranty information that can help a consumer if repairs are needed or recycling information that can earn them a credit for being environmentally conscious.

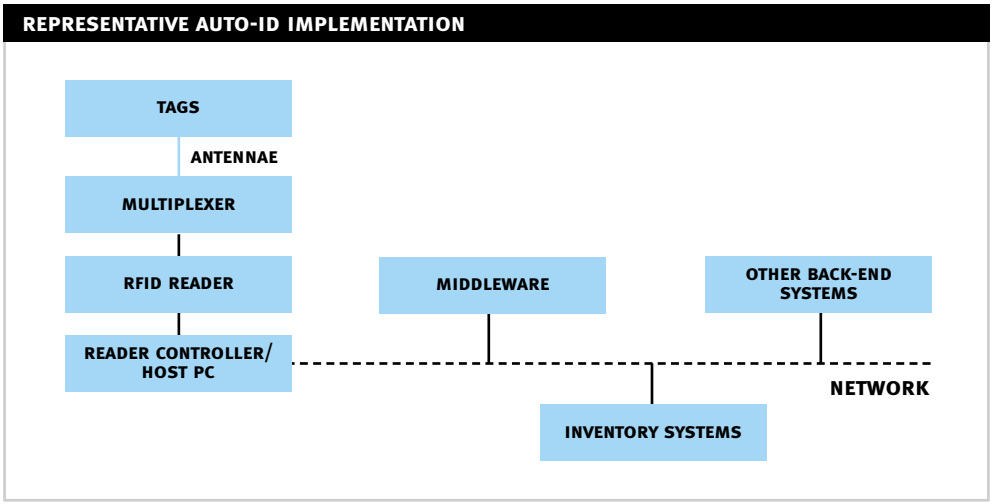
Even with education, there are some legitimate competitive issues. Retailers may see the technology as an aid to their competitors. For instance, since the EPC™ will be global and unique, it may be possible to determine specific product information from the EPC™ given enough data. Imagine knowledge of your competitors' shelf assortment and inventory levels gained through a store walkthrough, accompanied with a hand-held reader. This information is available now. The technology simply makes it easier to obtain.

12.3. The Elements of Cost

The Basics of Cost

Radio frequency identification (RFID) tags are the most frequently cited cost component in Auto-ID implementations. This is not the whole story. Tags, readers, antennae, controllers, middleware, operations and maintenance all contribute to the total cost of ownership. Only by factoring in all of these components, tailored to a given situation, can costs be accurately estimated. Figure 6 gives a schematic of the various components of an Auto-ID system rollout. This section outlines each of these components and offers recommendations to calculate the overall cost in a business case for Auto-ID.

Figure 6



Tag Costs

RFID **tags** are usually the first of the costs associated with an Auto-ID system. There are as many tag variants on the market as there are potential applications. Changes in form factor, memory capacity, read or read-write capability, active or passive configurations and range, all impact the cost of tags. When calculating tag costs, the application requirements are the primary driver.

The target cost of an Auto-ID Center compliant tag is five cents, i.e., read-only containing an EPC™. Note that this cost is a future "volume" target. By way of comparison, commercially available read-only tags in the UHF spectrum today cost approximately 50 cents per tag, in volume.

The cost of the tag is not the final figure. Conversion costs must also be factored in. Conversion in this case means application of the tag to a product's packaging, to the product itself, or to cases or pallets. It also implies associating the EPC™ code with the actual product, known as "commissioning." Commissioning may mean writing the preassigned EPC™ to the tag (or programming) or alternatively, reading the predefined EPC™ value on the tag. Then the proper PML associated with that particular EPC™ should be updated.

The product being tagged will greatly influence conversion costs; will the tag require a standoff (in the case of metal mounts)? Will the tag need to be concealed? Will the tag antenna be printed or metal coil? These factors will increase the baseline tag cost. How much of an increase depends on the application. If the tag requires a printed label, then a label printer/RFID writer may also need to be purchased.

Reader Costs

Readers energize passive tags with energy, receive the results and very often, handle the low-level anti-collision algorithms that allow readers to read more than one tag at a time. Readers are generally controlled via application programming interfaces (APIs) that are provided by the reader manufacturer. Generally, the API also allows for configuring the reader's read cycle, power or other settings. The API for a given reader may have additional costs associated with it, although many providers bundle the software.

Reader costs vary as a function of range, speed, robustness, network readiness and antenna capability. The longer, faster or more hardened a reader is, the higher the cost. For readers at the lowest end, a PDA application may run $200 USD. For shelf or forklift installations, readers may reach $2,500 USD, and for high-speed conveyor or dock door applications, from $2,500 up to $10,000 USD. These ranges are based on today's commercially available equipment, although they will drop as volume of readers produced increases.

Antennae and Multiplexers

Antennae are another component of the reader subsystem. Whether it is a shelf, mat, portal, wand or directional antenna, different antennae will be required for different applications. These can range in cost from $25 to $500 USD, depending on application and base operating frequency

Depending on how many antennae are required, one or many **multiplexers** may be necessary. A multiplexer allows many antennae to be physically connected to a reader. Expect to pay $500 to $2,000 USD per multiplexer, depending on the number of ports. A configuration using multiplexers may also require an additional communications card such as an RS-485 (roughly $250 USD) on the controller.

Lastly: **cabling**. As in high-end audio, cables really do matter. Although there are generally fewer limits on the distance between reader and controller, there are signal degradation effects in the cables connecting readers and antennae. High-grade RF cables for this purpose can be expensive. Look to spend up to $10 USD per linear foot, keeping in mind distance limitations.

The entire reader/antennae/multiplexer setup may be referred to as a "read point."

Installation

Installation is the next major cost. Physically mounting antennae, power supplies, multiplexers and readers can be costly, depending on the environment. Many readers will need to be installed in warehouse or industrial environments. Still others will be installed on equipment such as forklifts or various handling equipment. Retrofitting existing sites or material handling equipment can add to the cost.

Readers and antennae may need to be concealed if aesthetics are to be considered (such as in a retail environment). In the case of a warehouse or plant installation, equipment may need to be hardened to handle the environmental abuses that come with such locations. Power drops, often at union rates, must also be provided to the location of the readers. Depending on the environment (for instance, retail stores may not have power available at all merchandise locations) this cost may be considerable.

As with power, network capability may also be required. This is a "may" because the reader and controllers may utilize existing wireless LAN capability to communicate with other systems. Otherwise, some sort of connectivity will be required between the controller and the reader. This can be Ethernet (CAT-5) or other serial communication. This cabling must also be installed, shielded or concealed, depending on application.

Controller costs

For every reader or group of readers a **controller** will be required. A controller is simply a computer, running software to control the reader. Initial processing, event firing and some diagnostics run on this PC. The controller need not be a very high-end PC unless it needs to be hardened for factory or other industrial applications. Approximate cost: $1,000 to $3,000 USD.

Tuning

Another cost in an RFID solution is the **tuning** phase. Every physical environment will interact with radio frequency waves in a different fashion. The RF field will need to be measured for dead spots and adjustments made. This cost is highly variable, given the expertise needed, selection of reader systems, and the vagaries of RF fields.

Software Costs

The next level up from the hardware is the controlling software, or **middleware**. This software translates tag reads into business events. Middleware is where much of the action takes place and is justifiably receiving a lot of attention.

The middleware will be a distributed system. At the very least, it will run on one or more servers plus the software running on controllers. All middleware serves pretty much the same function: it translates tag events into business events, aggregates data from item-level actions to those used in current Enterprise Resource Planning (ERP) and Warehouse Management Systems (WMS) systems, and provides publish and subscribe interfaces, so that applications may register interest in business events. The middleware will provide abstraction layers for connecting various types of readers and will provide for basic business rule engines. Furthermore, middleware should provide for read point monitoring and diagnostics.

However, it is important to realize that almost every implementation of middleware will be highly dependent on business rules, existing systems and the desired level of control. Commercial variants of middleware include the Savant™ from the Auto-ID Center, Accenture's Silent Commerce Infrastructure, ConnecTerra, SAP's Adaptive Networks and Savi's SmartChain and UDAP. These all vary in cost, from free (in the case of the Savant™) on up, however their capabilities also vary greatly.

Integration Costs

No matter what the middleware chosen, integration costs will be a large factor in an Auto-ID implementation. It will be in the order of magnitude of the cost of readers and installation combined, depending on the number of legacy systems affected. It goes beyond simple integration. Some systems may need to be replaced altogether if they are not capable of taking advantage of incrementally large volumes of real-time data from Auto-ID technology.

Maintenance

In addition to one-time costs, the ongoing **maintenance** and upkeep of an Auto-ID system should be factored into ROI calculations. Factors influencing maintenance include hardware upgrades, replacement of failed or damaged equipment, ongoing firmware and middleware upgrades and any software or licensing fees. Also, ongoing tag purchases and battery replacement (for active tags) should be factored into operations and maintenance costs. A standard software license and maintenance agreement usually runs approximately 10 percent per year. This is a good estimate for these systems. Finally, since so much physical infrastructure is involved, the depreciation of equipment must be factored in as a cost item.

Workflow

The last pieces of the puzzle are the **process** and **human elements** of Auto-ID. Many existing processes, especially intercompany processes, will need to be redesigned. Current batch, or paper-based processes will need to be eliminated and reinvented. Essentially, new workflows may need to be created.

When more information is available through Auto-ID, increasing peoples' ability to act on that information must also be enhanced. Training of personnel in new processes and technology should be added into overall implementation costs. Journey management will become a necessary discipline in order to fully address Auto-ID implementation at scale.

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