

RFID

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BACKGROUND

Radio **F**requency **I**dentification (RFID) is a mature technology reinvented in the last few years. The process originates from the invention of devices that transmit radio frequency signals and devices that reflect that radio frequency signal. Manufacturers of the originally conceived RFID tags focused on an inclusive technology resulting in tags that carried all the relevant object information within the tag memory. Given original memory and transmission capabilities, tags were thus large and expensive. As a result, improvements in memory and transmission capability were limited to technology improvements in those areas. And improvements in those areas continue to be made. The power and impact of RFID was unquestionable, however the ability to implement this technology at a broad retail level was cost prohibitive.

REINVENTION

RFID's reinvention was the incorporation of the internet to convert an otherwise closed loop data collection system into an open, on line data collection system. Today's RFID can wirelessly identify, locate, and track items. Operating outside "the box" and driven by the demand for a low cost tag, entrepreneurs in the last few years have conceived an extremely different, alternative concept incorporating the internet. The internet, providing a broad access basis, enabled entrepreneurs to conceptualize tags that would carry LESS data, as little as a single unique number, but would be interconnected through the internet, to a data base which would provide extensive data. Unlike the UPC bar code that identifies a manufacturer and type of product (i.e. a half gallon of milk); this single unique EPC number (electronic product code) will identify a specific, individual half-gallon of milk. The specific information about that unique half-gallon of milk is stored in a master database accessible via the Internet. By minimizing data storage requirements, component requirements, and hence cost, could be minimized. It is clear the new RFID innovations will radically revolutionize the way businesses operate as well as the impact upon consumer privacy.

RFID continues to evolve; it is not well understood by the corporate community or the general public. However, just like wireless cellular technology, it needn't be completely understood in order to use it or grasp its basic operational principles. While we readily recognize the value of wireless cellular communication, imagine the same value and impact created by the wireless, automatic communication of information. A little technical knowledge will enhance one's ability to determine the cost/benefit of a potential system, identify needs, and provide a base for effective communication with potential suppliers and/or customers.

RFID: WHAT IT IS

RFID is an indirect line of sight; automatic data capture process using radio frequencies to transmit information between an object and the information management system. It is the only automatic identification technology.

The form of the interface can be that of sensing, identification or data carrying. At a minimum, an RFID system includes three components: a reader (a.k.a. transceiver), an antenna, and a tag/label (a.k.a. transponder) containing data storage capability. This process increases database accuracy, reduces paperwork, provides real-time operations information, and shorter order response times.

The objective of any RFID system is to carry data in appropriate tags and to update and/or retrieve data via wireless readers, at a suitable time, location, and speed to fulfill the application requirements. The data carried in a tag may be as little as a recognition code, a unique number, or complete information about the object, even warranty and operating instructions.

WHY RFID

Supply chain management is tremendously important and much underrated. It's a vitally important, incredibly complex, very sophisticated system. One of the reasons it's so valuable is because the whole global economy depends on people exchanging goods with each other. Hence, the whole global economy depends on the supply chain.

Ultimately, inventory exists because there is not enough information. The more information you have, the less inventory you need. RFID addresses three basic end user requirements: item identification, data carrying, and anti-theft protection. Further, it works in harsh environments and without human intervention, thus preventing human error. It provides real-time information about everything in the supply chain; where it is, how long it's been there, how fresh it is, etc.

As intense business competition continues, retailers are seeking ways to

1) Make the customer shopping experience faster and easier

Customers may spend hours browsing, but when it's time to check out, they don't want to wait. Currently retailers rely on bar codes to track their products, which must be individually scanned by a human and are easily rendered unreadable. Bar coding is a great technology, but many of the bar coding processes still require manual operation and leave room for errors or inefficiencies.

2) Increase operational efficiency.

People operate under an illusion about what really goes on in the supply chain. Receiving, counting, QA inspecting...that all takes labor at a cost. RFID can eliminate much of that time. In most environments, RFID can achieve 99.5% to 100% first-pass read rates. Further, with no moving parts or optical components, maintenance is not an issue. Some environments do not allow for line of sight between a reader and the bar code.

When stores receive merchandise from a warehouse, there is no way to verify carton contents versus packing lists, short of opening cartons and checking each individual item. While each item carries a barcode to enable scanning verification, the labor required to scan each item makes it impractical for most retailers. Bar codes may be very cheap to print, but you need people to scan them, and that labor IS expensive. The only reasonable alternative is to put up with the inaccuracies that result in their inventory databases from not validating their incoming merchandise against the packing lists.

Consider when items are placed on conveyors and tracked via bar code scanners on the conveyors. Packages that could not be scanned on the conveyor are often automatically rerouted through for a second bar code scan attempt. This dilutes the throughput capacity and productivity of your conveyor system. Further, consider the cost associated with manually processing all of the items that can't be automatically scanned with a bar code scanner on the conveyor. If you improve your automatic processing rate by 10%, then that's 10% of the packages you process that you don't have to pay someone to hand scan or hand sort.

3. Stock outs and theft

They are both symptoms of the same problem—a lack of accurate information about what's going on in the supply chain. If you have a stock out and the competitor has the product on the shelf, they get the sale. To reduce the likelihood of stock outs, greater inventory is carried. That costs money. The result could be carrying more inventories to make up for the lack of information.

If you knew there was a stock out or that someone was trying to steal a product, you could do something about it. The problem is not knowing when that happens. So with all the information available today through computer systems and bar code tracking, these situations still exist. The only way to solve this information problem is to find a way to automatically gather data about every single bit in the supply chain at all times. RFID can provide that through real time scanning of retail shelves.

RFID CAPABILITIES AND BENEFITS

While the cost of tags and readers, the main system components, will have a major impact upon when RFID is adopted, the key is the value generated by RFID implementation. There are a number of applications for which companies can employ RFID to gain early benefits. Early adopter applications may include inventory and supply chain applications or expensive retail products (i.e. electronic goods), both because of the high cost per item and the increased inventory control provided.

Benefits include decreased supply chain costs, instant inventory access/tracking, improved speed of logistics operations, improved security and error detection, and faster in-store checkout.

The primary benefit of RFID is it provides a *wireless link* that automatically connects people and objects with a variety of powerful information systems that speed commerce, track and protect property and promote overall end-user convenience.

RFID capabilities provide benefits that are impossible to achieve economically with any other automatic identification technology.

1. Non line-of-sight Identification.

Radio frequencies used to communicate between reader and tag easily pass through most objects (not with metal or liquids) that optical technologies such as bar code could not penetrate. You can identify people, items, and cartons even if an object comes between the reader and the identification tag. Because RFID does not require a line-of-sight condition, its first-pass read rate might be considerably higher. Fewer packages missed during the first pass means less time to sort the entire batch, reducing overall sort time and effectively increasing the capacity of the sorting/conveyor system.

2. Read/Write capability.

Most RFID labels/tags can be updated at the same time the tag is being read. Passive tags can usually be read from a further distance than which they can be written.

3. Cluster reading capability.

With appropriate software, an RFID reader can read many tags presented simultaneously. For example, if a pallet contains 40 master cartons, each of which contains 10 cartons of cereal, you could read each tag on all 400 cartons of cereal simultaneously. You can read RFID tags in groups eliminating material handling when tracking contents of cartons or pallets.

4. Quality

While the key benefit seen by many is inventory tracking and stock-out minimization, there are more significant applications such as quality control and process assurance that minimizes an organization's risk and brand damage. For example, was an incorrect ingredient put into a drug or food product? Was an entire product recall necessary because one questionable lot could not be isolated from all other product? Was a patient given a medication, only later to find out there was an allergic reaction? Was a medication sold past its expiration date? Was a tool or instrument not available at a critical moment, thus causing a production line shutdown or operational crisis? Did services go uncharged?

5. Right Sized Inventory

Analysts believe new generation RFID tags can reduce inventory requirements 5-25%. One of the original objectives of bar code was to improve inventory management and consumer transactions at the retail level. US retailers and consumer goods companies lose an estimated \$30 billion annually in sales due to stock outs. Retail shelves installed RFID interrogators will sense when products with RFID transponders are added or removed from the shelf. If inventory gets too low, the interrogator will send a message to the information network advising inventory be added to the shelf. If the shelf interrogator senses a significant number of products removed at one time it may send a message advising of potential theft.

6. Faster checkout

Today, decades later, over 5 billion bar codes are scanned daily worldwide. Bar code technology is being leveraged to the maximum in attempts to address continued demand for productivity improvements as well as consumer data collection efforts. However, there are limits to its capabilities. Because it is an optical technology, it requires a direct line of sight relationship, on a one-to-one basis, between the scanner and the bar code on the object. Conversely, RFID operates without a line-of-sight requirement, processes multiple transactions simultaneously, and is a read/write/rewrite data exchange technology capable of updating on the "fly." In a survey 33% of consumers preferred self-service rather than a human attendant for simple checkout transactions. Consumers stated the three most important advantages of self-checkout were shorter lines, increased speed, and privacy. Analysts think the efforts toward self-checkout can potentially increase revenues by driving customer loyalty and decreasing cost through more efficient labor management.

7. Durability

RFID tags can survive some harsh environments better than bar code. You can update an RFID tag more easily than you can print and apply a new bar code label, which lets you put variable data on a

tag that might have resided previously on a remote network server and required expensive access infrastructures.

MAIN ISSUES

Any RFID installation needs to generate a return on investment. While the benefits of use are obvious, there are currently a number of significant drawbacks.

1. Core system specifications: Getting data into the tag is the simplest issue. The key is accessing the data consistently, accurately, and over a distance suitable for a specific application. In order to achieve this there must be core specifications covering the four main areas: interface/communications; control; data storage; and energy source.
2. The major concern is the ramifications this technology can have on consumer privacy. Tags may be disabled at checkout, preventing the identification of consumer purchase information, though this also prevents some downstream consumer benefits such as instant coupons, warranties, and return merchandise convenience.

WHEN TO TRANSITION TO RFID

Many businesses wonder when it's time to adopt RFID technology. The temptation is to wait until your technology ceases to perform up to customer expectations. If you're currently satisfying your customers with a bar code tracking system, why adopt RFID? Waiting makes your company vulnerable. The primary reason to convert from a familiar technology (i.e. bar code) to an unfamiliar one (i.e. RFID) is because your current methods of satisfying customers and beating competition aren't working; you must change or you'll lose market share to existing or new competitors. You must change, or your business will die.

Executive Summary

RFID is the greatest technology to impact retail and manufacturing industries since the implementation of bar code. It addresses the main inefficiencies of bar code and increases customer convenience and inventory tracking accuracy. While there will certainly be continued enhancements to RFID, it has the potential to revolutionize the way industry conducts business. Currently, the main drawback to RFID is the high cost of transponders and interrogators, the main system components.

Certainly, improved efficiencies are available with RFID, but the ability to improve quality processes and minimize catastrophic mistakes is a capability not previously associated with item tracking and identification. Clearly, RFID is a more expensive data collection process than bar coding. On a standalone basis as an efficiency upgrade from bar code, it may not be a cost effective decision. However, in light of the quality and process control aspects potentially available through RFID, its worth taking a new perspective on investment payback.

While RFID provides solutions to the inefficiencies of bar code technology and will increase consumer convenience, it will largely be used in conjunction with bar code technology not as a replacement to bar code. In fact, new thermal transfer printers are capable of printing the bar code, human-readable text and graphics on the surface of a "smart label" and encoding information on the RFID chip layered beneath the label surface.