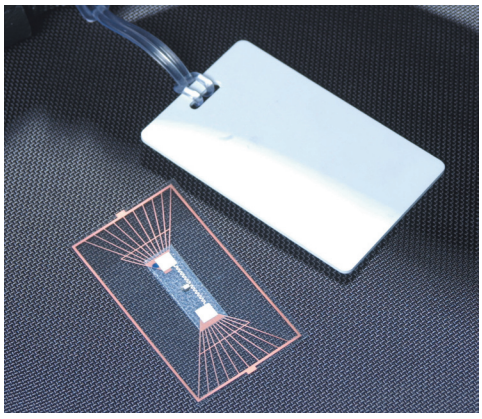
RFID for the Real World

Challenges and Opportunities
in the Warehouse and Distribution
Center Environment



MATERIAL HANDLING SOLUTIONS WORLDWIDE

FKI Logistex®

RFID for the Real World:

Challenges and Opportunities in the Warehouse and Distribution Center Environment

Executive Summary

Radio Frequency Identification (RFID) is one of the most promising new technologies to reach the warehousing and distribution sector in many years. While RFID technology offers a variety of benefits and advantages over current bar code ID technology, the cost of the technology and a number of technical hurdles have prevented it from attaining wide use in warehouse and distribution center operations. In the near future, while RFID technology strives to overcome these limitations and gain wider implementation, hybrid bar code-RFID systems will be the norm. Incremental implementations of RFID will provide initial successes and improve the learning curve for large-scale projects.

In this two-part white paper, we discuss the challenges of RFID adoption, and a common-sense, measured response to intelligently evaluating and implementing RFID. Every distribution center or supply chain is different, and a solution that proves successful for one operation may offer absolutely no benefit to another.

With gradual experience and the guidance of a trusted partner, the combination of greater proficiency and greater investment can unlock the hidden value that RFID technology can provide to an organization.

Part One: The Challenges of RFID Adoption

RFID is the hot topic in material handling. Attend a trade show or an industry meeting, or have a discussion with a material handling professional, and conversations will inevitably turn to RFID. Predictions of the rapid adoption of RFID technology are rampant, but as with many forecasts about new technologies, the likelihood of these predictions immediately coming to fruition is slim.

RFID will potentially see widespread adoption in the longer term, and organizations that have experimented with this technology have already found benefits. Those benefits—improved lead time, accuracy, information flow, and cost savings—will provide competitive advantage to those organizations that have been able to successfully adopt the technology.

On the other hand, the world will not convert from bar codes to RFID overnight. Not every application in every business will accrue benefits simply by converting to RFID. Hybrid bar code and RFID systems will be the status quo for years to come. As with any new and evolving technology, leaping ahead to the cutting edge is generally not the wisest course of action.

What Is RFID?

RFID is an Automatic Identification and Data Capture (AIDC) method. First developed in the 1940s as a way to identify allied and enemy aircraft in World War II, the technology has evolved for use in the railroad industry to track railroad cars, in the automotive industry for automation and tracking processes, in agriculture and wildlife management to track livestock and wildlife, and in retail as an anti-theft device.

Spurred by mandates from the U.S. Department of Defense (DOD) and large retailers like Wal-Mart, RFID has come to the forefront as an effective way to track goods through the supply chain. Much of the clamor in the media about RFID has come as a result of these mandates.

RFID implementation is in a relatively embryonic state, particularly in the warehouse and distribution segment. With considerable hype about its potential cost savings and reach, a dizzying variety of technology vendors and solutions, and an uncertain base of standards set for its use, the near-term future of RFID adoption is still largely uncertain.

Survey work by AMR Research indicates that the top 100 suppliers required by Wal-Mart to use RFID have invested only $250 million to meet the minimum requirements of the mandate, far short of initial expectations of the investment.

In the supply chain, RFID presents the opportunity for increased material and product visibility through its ability to track and identify containers and their contents throughout the manufacturing or distribution process. RFID provides particular value when traceability through process or life cycles is required; where labor costs, labor constraints or data errors are high in material identification or handling; and where business systems need more information than automatic identification technologies like bar coding can provide.

The research further indicates that the relatively high cost of hardware, software and RFID tags has caused these companies to patch systems together just enough to meet compliance deadlines. AMR also says that limited and isolated implementations of RFID will be the norm for the immediate future. However, AMR recommends that organizations should look to implement this technology in high-value product areas—consumer electronics, DVDs, pharmaceuticals, high-end apparel and sporting goods—where there is more likelihood of a strong business case.

How RFID Works

RFID systems start with two main components—RFID tags and an RFID reader. RFID tags can be passive or active. Passive tags are energized only when they are in a reader's RF transmission field, while active tags are battery-operated and constantly emit an RF signal. The operation of an RFID data transmission is basically the same no matter the type of tag. When energized, RFID tags emit a signal several hundred times per second. When they pass within the range of an RFID reader, the tag information is received by the host system. The host system then filters the multiple signals and begins processing the information. With readers strategically placed throughout a warehouse or distribution center, the tag and its respective product or item is followed along its journey through the supply chain.

RFID tags can be read-only or read-writable. Read-writable tags allow the information stored on and emitted by the tag to be modified or rewritten during use. Passive read-only tags are the most affordable tag option available. They are also the most limiting, because their signal reach and data use is constrained.

An important variant of RFID tags is the Auto-ID tag, which is encoded with an electronic product code (EPC), a 96-bit unique naming scheme that can provide vast product detail. EPC is currently the most common encoding scheme for warehouse and distribution applications. EPC tags can be active or passive, read-only or read-writable.

How Bar Codes Compare to RFID

The first task in considering an implementation of RFID is to evaluate how the new technology compares with current bar coding technology. Bar codes are well understood at this point and their challenges have long been addressed. While bar code labels are inexpensive, widely used, and based on open standards, they present the disadvantages of having a line-of-sight requirement; the constraints of limited, static data; and the problems caused by inconsistent print quality.

RFID tags do not require a line of sight, which eliminates the need to de-scramble products. They have a longer read range, allow changes to the stored data, provide more information than bar codes about the item or the contents of a package, and outperform bar codes in adverse

physical conditions. Also, the volume of data that RFID tags provide can lead to elevated operational awareness and supply chain visibility.

However, RFID is more expensive than bar code technology; RFID standards are still evolving; and physical limitations, such as interference, can affect RFID performance. Another potential disadvantage is that the volume of data that sets RFID apart from bar codes can become a burden on existing networking and host systems.

Does RFID need to replace bar code use entirely? Some in the industry believe that the relatively inexpensive cost of retaining a bar code on an RFID-tagged item or container presents a level of backup to RFID systems in the event of lost RFID tags, misreads or errant information. Retaining bar coding also seems to make sense in terms of its minor demands on packaging and container real estate.

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"There will almost always be the need for a printed label that acts as a human-readable backup in a system using RFID," says Frank Goodfinger, vice president, strategic partnerships, SICK, Inc., a major provider of sensors, safety products, and automatic identification products, and a global leader in bar code technology. "Once you decide that a human-readable label is required, making space for a bar code should have an almost insignificant impact on the label's cost or design.

"As an incrementally costless backup that provides an important level of identification assurance, the combination of a bar code and RFID tag would seem to be as perfect of a world as you can get today. That means that until, and most likely after RFID is widely adopted, many environments will need to retain dual bar code-RFID ID.

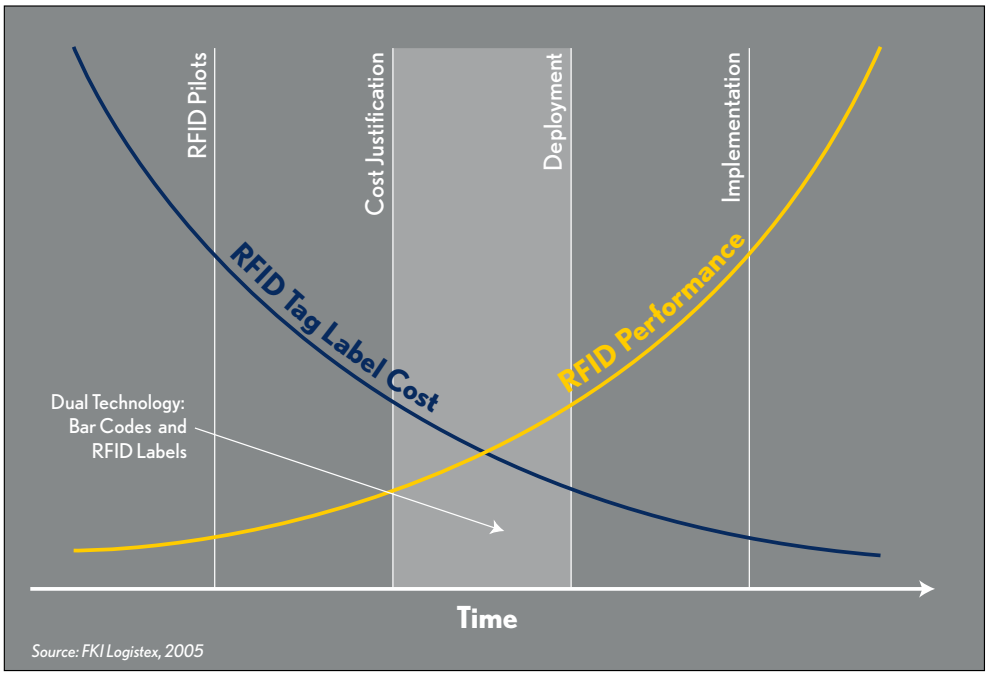
"The technological and logistics infrastructure to support end-to-end RFID use is also not presently available in the wider marketplace," adds Goodfinger. "In most present-day situations, organizations using RFID will be limited in its use to the four walls of the facilities where they have implemented RFID. Because bar code use is in such wide penetration in the marketplace, for the near future it will be the predominant end-to-end ID technology."

Cost Versus Performance Of RFID Technology

As illustrated in Chart 1, Bar Code to RFID Timeline, the cost versus performance measurement of RFID looks like the prototypical supply–demand curve from economics. As the RFID performance curve climbs to the right, there is a point at which the performance, or benefit, provided by using RFID tags begins to exceed the cost of the tags. It is at this point that adoption of RFID potentially begins to make business sense.

In today's warehouse and distribution environment, while many seem to be focusing on the absolute cost of the tag, it is still far more important to study the relative cost of the tag versus

Chart 1: Bar Code to RFID Timeline



the benefit it is providing in any given situation. In many manufacturing applications, for example, a ten-dollar tag is very inexpensive when compared to the next best solution or to the cost of the problem that is solved. Still, the market in many instances appears to be looking for a mythical five-cent tag that makes it possible to apply one to each carton or to each product. In either case, the specific situation should dictate the specific tag cost that will allow an implementation to be successful. This is no different than the early stages of adoption of bar coding.

As RFID is more widely adopted, the cost of tags will fall in typical supply-demand fashion. An RFID implementation that is too expensive today may become affordable in a matter of time.

All indications are that RFID adoption will eventually grow. It is likely that the next few years will be spent making operational and software changes that will enable the benefits of RFID to impact organizations on a wide scale. Initially, there is likely to be heavy investment in software, services and readers. This investment will decrease as standards are consistently applied and as integrators gain proficiency, and spending will shift to tags. As that happens, the cost of the tag will decrease.

"You can't talk about the cost of a tag without mentioning the elusive five-cent tag," says John Shoemaker, vice president, RFID division, Symbol Technologies, a global leader in enterprise mobility solutions, advanced data capture products, and RFID technology. "But the issue of the cost of an RFID tag depends on how you define a tag. Some people think a tag is a chip

attached to an antenna. Some people think a tag is a chip attached to an antenna on a substrate with some printing on it, maybe a bar code. There are others who think that a tag is that whole inlay embedded in an adhesive label.

"The availability of tags is also going to be a problem in the industry over the next year," notes Shoemaker. "A lot of companies have procrastinated, they waited until the last minute, and they're just now placing their orders. It's going to take some time for the industry to ramp up to meet the demand.

"Nobody is going to wholesale replace bar codes tomorrow; that's not the intention. There is an intention to transition, to migrate over time to RFID over the next decade or more. Companies like Wal-Mart will not be able to scale to a trillion dollars in revenue using the limited information provided by bar codes. They have to do it with the next generation of technology, and that's going to be RFID.

"As an industry, the long-term success of RFID is going to rest with companies that have scale and technology, including technologies that complement RFID, who will be able to offer a complete solution," adds Shoemaker. "Customers don't want tags and readers. They want a solution."

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Summary

Current RFID tag technology offers a number of constraints when compared with the ideal tag technology, which would be low-cost, reduce no-reads to zero, and offer flexibility for antenna design. It would also provide high-yield process expertise, allow in-process testing and quality control, and provide vendor-neutral standards compliance. Lastly, the ideal tag would fully integrate the tagging and labeling process, provide an integrated and flexible label conversion process, offer high-speed read/write capability, and be environmentally friendly.

Existing RFID tag technology, on the other hand, presents a number of challenges. Tag prices are relatively high, no-reads are a problem, and the size and shape of antennas remain fairly inflexible. Existing tag technology also features limited process information yield, proprietary and non-standards-based limitations, as well as reliability and logistical issues, including tag damage in the label conversion process, the speed of read/writes, and problems in the integration of tagging and labeling. In addition, the metal content of RFID tags presents an environmental issue. While these and other challenges should be tackled as the technology moves closer to the mainstream, in the interim they will slow down the adoption process.

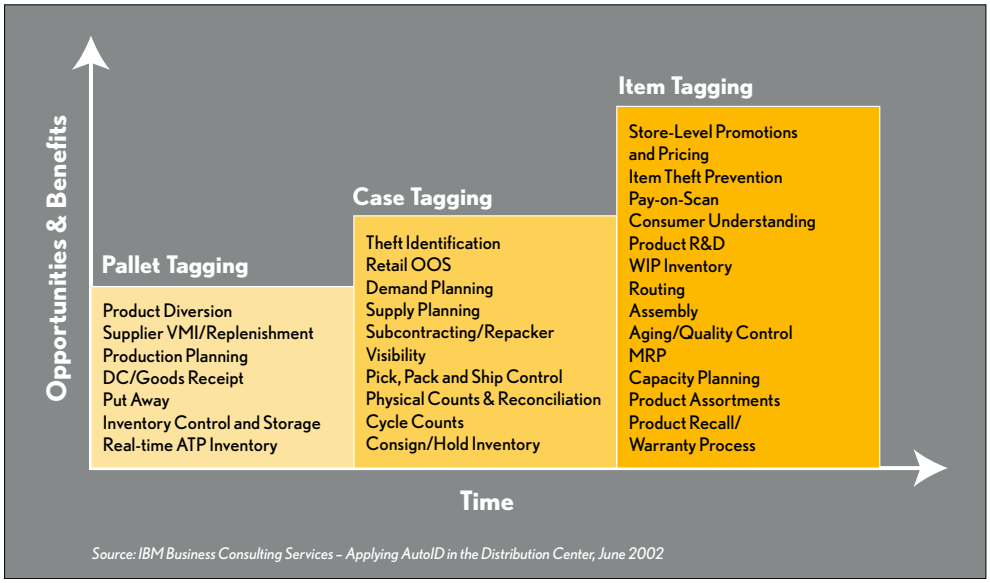
Part Two: RFID Implementation Opportunities

An understanding of RFID technology and a grasp of the limitations of current technology is helpful when evaluating the benefits of an RFID implementation and its potential impact on an organization. The initial benefits of RFID in a warehouse or distribution center environment will be mainly derived from automating manual processes and effectively using greater amounts of data. Still, these simple concepts provide varying benefits and solve many different problems. For example, using RFID tags to automate the receiving operation can not only reduce the labor cost for that function, but also enhance accuracy and help decrease the amount of time that a carton spends in a distribution center.

At varying levels of RFID use, from pallet tagging to case tagging to item tagging, there are corresponding benefits that accrue. Chart 2, Benefits Accrued at Different Levels of Tagging, details these benefits. At the pallet tagging level, RFID offers improvements in product diversion, production planning, inventory control and storage, and vendor-managed inventory programs, among other places. At the case tagging level, RFID presents opportunities for improved demand and supply planning, theft identification, and pick, pack and ship control. In item tagging, RFID allows a variety of benefits, including store-level promotions and pricing, item theft prevention, and capacity planning, among many others.

In order to achieve these benefits, distribution centers must match the benefits of RFID with the actual problems and limitations of their own operation. There will certainly be opportunities for quick wins in many organizations where the benefits are so simple to achieve that the decision becomes obvious. As illustrated in Chart 3, Potential Areas of Benefit from RFID Versus Bar Coding, there can be tremendous returns in isolated areas of an operation

Chart 2: Benefits Accrued at Different Levels of Tagging



Source: IBM Business Consulting Services – Applying AutoID in the Distribution Center, June 2002

along with opportunities for significant cost savings. These include automated and accurate inventory management, reduced paperwork, reduced inventory, and automated checking processes. Matching an organization's biggest problems with some of the areas offering the highest benefit will allow some early successes in adopting RFID.

While cost and implementation challenges prevent most organizations from attempting a wholesale conversion to RFID, it makes sense to pick some high-probability projects to show a quick return on investment. Taking this approach means organizations will have to live with a hybrid bar code-RFID environment for the immediate future. However, taking into account the challenges and hurdles of existing RFID technology, including cost, means success will be more likely with short, well-defined and targeted projects. These early successes will not only help an organization, but they will also lay the groundwork for successful future investment in the technology.

Chart 3: Pontential Areas of Benefit from RFID Versus Bar Coding

Area	Activity	Benefits of RFID over Barcode	Cost Reduction %
Warehouse	Storage	Automated, accurate inventory management	28%
Warehouse	Dispatch	Automated checking process	26%
Supplier	Claims Management	Automated, accurate data records decrease claims generated	18.5%
Hub	Cross-Docking	Automated checking, reduced paperwork decrease admin	18%
RDC	Receipt	Automated checking process	9.4%
RDC	Claims Management	Automated, accurate data records decrease claims generated	20.8
RDC	Dispatch	Automated checking process	5%
RDC	Storage	Automated accurate inventory	21.7%
All	Inventory Cost	Reduced inventory due to visibility through supply chain	55%
All	Asset Utilization	Improvement in asset utilization	30%
Retail	Receipt	Reduced paperwork	2.8%
Retail	Storage	Automated inventory management	16.3%
Retail	Replenishment	Improved efficiency	4.5%
Retail	Losses	Reduced loss (out of code, overstocking) from inventory visibility	11%

Source: FKI Logistex, 2005

The following presents a few examples of how RFID can be applied to specific areas of a distribution center. While they are not meant to be a perfect fit for an organization's specific situation or to represent all potential applications, they are among many concepts that may work when adapted to function within the framework of a specific operation.

Shipping & Receiving

One of the better opportunities for a successful RFID implementation lies in the automation of the receiving operation. In this process, pallets or cartons are tagged with RFID EPC codes. RFID readers on the dock door read the information as the containers pass through.

RFID-tagged containers carry far more information than those tagged with a bar code. As a result, the simple act of driving a lift truck carrying RFID-tagged containers through a dock door portal scanner automates an entire series of transactions that would otherwise have to be performed manually. In a bar code system, an operator would have to scan the containers, reconcile them with a purchase order, verify that the proper product was actually in the carton, and then most likely add a bar code label to the carton for internal processing.

With RFID, this process can be completely automated. Detailed product, container, purchase order and other information now accompanies the container. Once scanned, the warehouse management system (WMS) can automatically identify the shipment, reconcile it with a purchase order and determine its routing based on knowledge of the actual product in the carton.

This level of automation improves the speed of processing, reduces the manual labor requirement, and allows the business system to make faster decisions on handling that container or product. Taking advantage of the improved information flow can reduce inventory requirements, as this type of cross-docked environment reduces the amount of time that inventory is in the warehouse.

RFID scanning provides higher accuracy rates than bar code scanning, allows higher speeds and throughputs, and offers significant labor savings. It also prevents misshipments during the load process, enables put-away when an electronic data interchange (EDI) or advance shipping notice (ASN) has not arrived, and yields faster and more accurate exceptions handling. Dock door RFID scanning also works well in a mixed bar code-RFID setting.

Similar results to dock door scanning occur when RFID scanning is used for quality control and packing scanning of items selected in a pick-to-light environment. RFID makes it easy to determine which products have been picked and provides more business intelligence than bar codes for the quality control

Real World Challenges of RFID

In planning for an RFID implementation, several important facets of an organization's operations and products should be carefully reviewed for changes that can enhance RFID results. Some of these areas include data management and integration, package engineering, site engineering, and device management.

Data Management & Integration

As previously mentioned, an RFID system will create dramatically larger data flows than previous operations. Depending on the intelligence and filtering built into a system, changes to the entire network—from controls to bridge PCs to WCS and WMS systems—may be required in order to properly handle the influx of data. More importantly, the data must not only be processed, but also turned into useful information that will allow enhanced real-time decisions.

Organizations planning RFID implementations may not need a wholesale transformation of their systems, but should carefully evaluate the capacity of existing systems to handle significant changes. Handling the volume of data, as well as RFID-specific data, is one issue, but more critical is the need to build additional intelligence into the system to leverage the increased

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process. RFID scanning also automates the quality control process, minimizing the manual labor requirements needed to achieve it.

Lift Trucks

Another measured way of taking advantage of RFID is to mount readers directly on lift trucks. In today's warehouse, lift trucks are commonly equipped with wireless-networked computers and are capable of sending and receiving information and changing work instructions on the fly. With RFID readers on lift trucks, a warehouse can automatically read RFID-tagged pallets. This not only reduces the manual requirement of reading pallet labels, but also acts as a verification step to ensure accuracy. The reduction of errors translates directly to lowered cost through reduction of manual handling and rework.

Once readers are affixed to lift trucks, the WMS can take advantage of the information provided by the reader to determine in real-time the exact location of the lift trucks. With this extra information, the system can replan the work of any or all the lift trucks to adapt to the current situation. This can result in the ability to process rush orders by sending new work orders directly to lift trucks. It also provides the option of reallocating lift trucks to process orders that are falling behind. As with the general use of RFID, the more intelligence is added to the software, the faster it can adapt to customer and supplier demands at any given time.

Lift truck RFID scanning provides a number of other benefits. The process automates the loading process with bill of lading and ASN information, provides location information for pick-and-place activities, and offers higher throughputs as a result of the increased information flow. Lift truck RFID scanners are cheaper than dock door scanners and also work in a mixed bar code-RFID environment.

Sortation & Conveying

One last area for initial potential gains in RFID use is in the area of sortation. Once the decision has been made to utilize RFID tags in a warehouse, it generally makes sense to continue reading that tag in downstream processes, including sortation.

The benefits realized in the use of RFID in sortation will vary greatly by the type of system. In baggage handling, for instance, where bar code read rates are as low as 85 percent in many cases, the amount of manual handling required to quickly move a bag to the correct airplane easily pays for the addition of RFID tags.

In most warehouse and distribution applications, the results will not be as dramatic. However, considering the amount of manual handling required for no-reads, coupled with the difficulty in verifying with absolute certainty that the right

knowledge provided by the tags and additional scanning. To gain this added intelligence, an operation's WMS may require additional modules.

If an organization's WMS is not able to make immediate use of the data, it is likely that operations will not be impacted enough to provide a significant return on the investment in RFID. Though automating processes via RFID will provide some benefit, customers will not be better served until the capabilities of the WMS are enhanced to further improve operations, such as decreasing order lead time or increasing order accuracy.

Data integration is also another important area to consider. Not only will legacy systems have to work with RFID data, they will have to integrate with each other. The real-time data flows that RFID provides present an additional challenge. The integration of real-time RFID data for systems currently in non-real-time transactional states, either in part or in whole, may require further change.

Package Engineering

Another challenge in RFID implementation is package design. Initially, product packages or cartons specifically designed in size or shape to accommodate bar codes will be tagged

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cartons were sorted to and loaded on the right truck, the payback period for an RFID sortation implementation can make the investment justified.

In the case of shipping sorters, RFID can change the basic premise behind how cartons are routed. With EPC codes on RFID tags, the controls system or warehouse control system (WCS) can reroute packages dynamically based on the contents of the package, rather than only the WMS knowing what is in a carton. The controls system or WCS in a non-RFID environment only sees a license plate ID code that is simply a static serial number.

Additional benefits of RFID scanning during sortation and conveying include higher accuracy rates and the ability to read information from any side of a container or box. Implementing RFID scanning in sortation also leverages the existing large infrastructure technology investment in a warehouse or distribution center and is compatible in a mixed bar code-RFID setting.

Opportunities

While there are many other examples of how RFID can add value to an operation, the basic premise is clear. Automation of manual processes and more dynamic decision-making through the use of previously unavailable real-time product data can assist organizations in better serving customers. At the dock door, on lift trucks, or in the sortation process, RFID deployment can leverage existing infrastructure investment to provide a higher return on technology assets. While the benefits of RFID implementation vary by area within a facility, limited deployment of the technology in a dual bar code-RFID environment can provide significant process improvements with minimal disruption to present operations.

Lessons Learned

The limitations, costs and learning curve associated with present RFID technology can render RFID implementation difficult or impossible for many warehouses and distribution centers. This was true also for bar codes in the early stages of that technology. As there were benefits and drawbacks to working with bar codes then, there are benefits and drawbacks to working with RFID today. Some of the challenges are difficult to overcome; others are not. As with most new technologies, the implementation issues are separate from the problems associated with the existing technology. In the long run, the marketplace will solve most of the problems with RFID, leaving those issues that are insurmountable to define the limitations of the technology.

The following lessons learned during past RFID implementation projects can help set the framework for a successful project in the future.

with an RFID tag. With the new rules that apply to RFID tags, there may be an opportunity to remove some of the earlier constraints of packaging or to consider building an RFID tag into the package for use throughout the supply chain.

As there are limitations to bar codes, there are limitations to RFID. While these limitations are different, changes in product packaging may need to occur to address this shift in requirements. The major issue with bar codes is in dealing with odd-shaped or very small packages. Bar code readers function more effectively when the bar code is presented on a flat surface parallel to the front of the reader. Packages must also reach a minimum size in order to provide space for placing the bar code or the entire packaging label. With RFID, the package size or shape is irrelevant, and an opportunity exists to alter a specific product or package for an RFID environment. However, liquid and metal packaging components present reading issues for RFID systems.

Package designs also need to take into account the type of tag to be used, and the potential need to accommodate both bar codes and RFID tags. This can affect the geometry of the tag antenna, and consequentially, the read. An additional consideration for some

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High-Speed Sortation Environments

In high-speed sortation environments, where product is sorted at speeds upwards of 600 feet per minute, RFID is typically a bigger challenge than most anticipate. While RFID read rates are much better than those of bar codes, a dilemma presents itself. While RFID scanners can read tags that are not within the reader's line-of-sight, the reader can potentially read any tag in its vicinity, making it difficult to identify which carton belongs with which RFID tag.

With bar code scanners, on the other hand, there is certainty that the tag being read is directly in front of the reader. Implementing RFID scanning in a high-speed sortation environment requires experimentation in the read process. While this can be problematic initially, RFID systems can achieve nearly 100 percent read rates and successfully identify every carton with few errors.

Once read problems have been worked through, RFID scanning can often allow smaller gaps between products or cartons. This enhances throughput, as long as the underlying mechanical and control system can process the additional flow.

However, greater throughputs can push the limits of a network, as RFID readers can process more than 100 tags per second. A network type—e.g. serial, Ethernet, DeviceNet, etc.—that was originally chosen based on the requirements of a material handling system can be crippled by the radically changing throughput, message sizes, and bandwidth requirements presented by RFID. The changes may render the system inoperable until a more appropriate network scheme is selected.

Data Flow/Filtering

The amount of data present in an RFID tag may result in data flows 100 times greater than those delivered by a bar code. Though most database systems can handle this volume, machine-level control systems or WCS software based on older and lower-bandwidth networks may not fare as well.

The distance between readers and physical divert points on sorters is typically calculated to ensure that a carton's routing information is known prior to reaching its first divert point. Changing the data flows or network scheme in an RFID implementation may require reevaluation of an operation's physical layout as well.

The amount of data on a single EPC-compliant tag is just one cause of increased data flow in an RFID environment. A potentially much larger issue is the removal of line-of-sight limitations. Because RFID scanners can read an entire pallet of carton tags at once, or even every tag within a given area, there can be a dramatic increase in the amount of data read on networked readers. A reader mounted on a conveyor is guaranteed to read individual tags multiple times, as opposed to the single read in a traditional bar code system.

organizations is the environmental concern presented by the metal contained in RFID tags.

Site Engineering

When implementing an RFID project, organizations must consider current procedures and practices and be able to test the impact of a change prior to rolling it out to the entire operation. Will the portal readers at the dock door read only products passing through the door or will they also read the pallet at the next door? Is the RFID antenna at the shipping sorter also reading the stack of cartons sitting next to the conveyor? Will the application require a composite section in order to facilitate bottom reads from an RFID array? Does the conveyor layout mean that an RFID reader on one line will read packages on another? Ensuring adequate coverage without overlap is very important in assuring that a system sees every package it needs to see without seeing others. This will generate a great deal of unnecessary "noise" passing over the network, and needs to be considered. Physical "noise," such as RF and electrical interference, can also be an issue in site engineering and design.

Device Management

With hundreds to thousands of RFID readers and printers currently on the

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In order to make sense of this data, and to ensure that the network is not overloaded with redundant data, RFID systems require multiple levels of data filtering. In the first step of the filtering process, the RFID reader will separate the good reads from the bad. The controller will then identify individual cartons or pallets. Next, the WCS will differentiate between information needed at the WCS level for decision-making and information needed at the WMS level. This need for filtering has already led to specific devices to filter data on a network and to an entire class of software called edgeware.

Whatever the technique used, data filtering will remain an important part of a successful RFID implementation, as will the question of whether existing systems are able to handle the large influx of data that RFID systems provide.

Baggage Handling & Screening

Early deployments of ultra high frequency (UHF)-based RFID baggage handling and screening applications by FKI Logistex have yielded significant lessons about the real world of RFID implementation. For example, the FKI Logistex RFID implementation at Jacksonville International Airport (JAX) in 2002 confirmed that 900MHz, or UHF, is the best frequency available to accomplish the task of reading products on a moving conveyor. Other frequencies simply required too much power and did not provide enough read range for the application.

The Jacksonville project, initially a pilot inline baggage screening effort with the Transportation Security Authority (TSA) and later the world's first permanent UHF RFID system and the first 100 percent inline hold-baggage screening (HBS) system in the U.S., also revealed that conventional metal conveyor sections would not allow bottom scanning. Instead, composite conveyor sections had to be used. While these proved essential for read rates, proper grounding of the composite conveyors was required to avoid damage to the RFID readers.

Another important early project requirement was to identify and read only the RFID tags used in the baggage handling process, so as to not confuse other tags within the luggage with the RFID baggage tag. In comparing different technologies, it was also found that technological limitations could sometimes be advantageous. For example, RFID's inability to penetrate metal meant improved read rates of luggage inside metal containers. The system was set up so that RFID signal energy entered the baggage containers through a small canvas door as the baggage passed by a reader. The RFID signal reflected off the metal, enabling the system to read more tags and to read those tags multiple times before the signal exited through the canvas opening.

market, device management is another issue to consider in implementing RFID. Additional considerations include the fact that RFID devices will be distributed throughout the facility; that installation and recognition can take experimentation; and that management, upgrades and device repair add another level of work requirement in an operation. To keep the system running as needed, additional network management, as well as the application and update of machine and business rules, will be required. In addition, while it appears that the current favorite, EPCGlobal, will be the likely winner, it is still uncertain which RFID standard for device management will be adopted.

At McCarran International Airport (LAS) in Las Vegas, which processes more than 20 million bags per year, several challenges were also overcome in deploying RFID in place of bar codes. One of the first requirements was to supply a redundant RFID solution for the McCarran project, on schedule as the world's first RFID 100 percent sort-track-and-trace airport installation. For critical path processes, a redundant solution was required to ensure system operation when primary equipment failed. To accomplish this, a single four-antenna array was connected to multiple readers in a configuration that allows any of the RFID readers to address the antennas in case of reader failure.

The next challenge at McCarran was to singulate RFID tags in a sortation system. With more than 70 arrays installed in the system, ensuring that the correct information was associated with the luggage being read in the field was critical for security and for proper sortation of the baggage. While it was possible to read and singulate luggage when all luggage pieces had a known, working RFID tag, identifying luggage in the read field that was missing a valid tag upstream and downstream presented a challenge. After extensive research and engineering, a combination of software, hardware and shielding enabled the system to accurately singulate the RFID tags, even when individual tags were not present.

These and other real-world lessons learned from early RFID implementations indicate that systems originally designed for bar code technologies may require rework and re-planning to accommodate RFID or multiple ID technologies. These projects also indicate that the amount of new software and interfaces needed increase when multiple ID technologies are required. In general, the move to RFID systems will require IT changes to bandwidth, storage and infrastructure, as well as careful planning and research to ensure successful implementation.

The promise of RFID is enormous, but there are real-world challenges. As with any new technology, understanding the challenges of RFID is critical in order to avoid starting an RFID project that does not account for these complexities or tries to achieve something the technology simply cannot do. In the foreseeable future, while the technology matures, managing dual bar code-RFID systems will continue to be the norm.

The Near Future: Managing Dual Technologies

There are many issues to consider in planning for an RFID implementation, and the answer to every question will vary with the specific circumstances of the organization. RFID on its face is neither simpler nor more difficult to implement than bar code technology. But it is very different—in how it is implemented, in the benefits it can provide, and in the functions that it can perform.

Each area of an organization should be evaluated independently to determine where RFID can provide additional functionality or results that cannot be attained today with bar coding. To do this, an organization must evaluate where it can streamline a process through automation or where it can better serve its customers by making more dynamic decisions based on the real-time data that RFID provides.

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Until RFID reaches full maturity, it will also be critical to understand the capabilities of automation partners when undertaking initial RFID projects. Their experience in learning the parameters can enable an organization to move quickly up the learning curve. Whether an organization chooses a partner that has already worked through many of the issues, or a partner that will learn as the project progresses, knowing that partner's experience level before starting a project will provide a realistic idea of what to expect.

FKI Logistex, as a global provider of integrated material handling solutions, is one of the world's leading designers and suppliers of RFID-enabled material handling systems. FKI Logistex is actively involved in projects across all markets, including baggage handling and security; parcel; postal; warehouse and distribution, including the retail market; manufacturing component and package handling and distribution; and libraries. With more than 2,000 material handling professionals, 1.9 million square feet of manufacturing space and thousands of successful implementations, FKI Logistex has the resources and the experience to solve the toughest ID, track and trace challenges, anywhere in the world. As RFID technology continues to grow in presence and value, FKI Logistex is committed to remaining a trusted partner for its application and integration.

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