Enterprise-Wide Data Collection and RFID/Bar Code Printing for SCM
Executive Summary

Forward-thinking businesses thrive on information. Companies that fail to provide accurate, timely information to their supply chain partners are at a competitive disadvantage. Many proven productivity tools like radio frequency identification (RFID) and bar code shipping labels have become a requirement for doing business demanded by progressive supply chain management (SCM) processes.

This paper presents how advanced RFID and bar code technologies can create sustainable advantages by providing the information required for modern business practices. It addresses how RFID and bar code data systems improve the performance of enterprise software applications. Then, it summarizes the general benefits of RFID and bar coding, showing how to improve efficiency and costs from receiving, through production, quality control, and shipping—to the item level.

Benefits of RFID and Bar Coding

Participants at all points in the supply chain and manufacturing process must produce and provide timely, accurate information, or productivity and profitability will suffer. Achieving supply chain visibility—being able to know where an item or shipment is within the supply chain or retail floor at any point in time—is a high-priority initiative within the industry. This could include a product in the store, work in process, or raw material, front-to-back. Companies without good information carry excess inventory to ensure they can deliver on their promise. Replacing excess inventory through improved information reduces storage space and labor costs, expands asset utilization, increases inventory turns, enables faster billing cycles, and significantly contributes to cash flow.

To gain more information and visibility into their operations, many companies depend on enterprise resource planning (ERP), supply chain, customer relationship management (CRM), and other management software. These applications can be highly effective, but cannot deliver their full potential when the data they require is not timely or unavailable. That is why RFID and bar codes present the most cost-efficient and effective methods for providing accurate supply chain data to enterprise applications. In addition, software performance improvements will benefit directly from advancements in RFID and bar code traceability technology.

Scanning an RFID tag or a bar code, which produces greater than 99.9 percent data accuracy, is a far superior method of entering data into a host system than key entry by word processing or manual record keeping with pencils and forms. A widely accepted study found that skilled typists make one error approximately every 300 keystrokes; error rates for less skilled warehouse and production workers are much higher. If a simple inventory application requires workers to write down a 10-digit product serial number, one in 30 records would contain errors. ERP systems reuse the same data for many different applications. Thus, seemingly innocent transcription errors on the shop floor can later cause big problems in inventory, planning, and customer order tracking systems.

DePuy Orthopaedics, an orthopedic manufacturer, determined that each error in its shipping process cost between $35 to $55 to detect and correct. Since eliminating manual data entry with a bar code system for shipping operations, the Zebra customer has saved several hundred thousand dollars.
Achieve Deep Traceability with RFID

Manufacturing, distribution, and retail operations are increasingly adopting RFID tags. Item-level tagging, package validation, and food traceability are just a few of the critical applications receiving benefits. The tags include an RFID transponder, commonly called a “smart label,” to complement the bar code and text on the labels. Unlike bar codes, RFID technology requires no line-of-sight between the object and the reader. This solution enables the identification and recording of entire pallet loads in less time than it takes to scan a bar code shipping label. The U.S. Department of Defense (DoD) successfully pioneered pallet tracking with RFID, and private sector businesses were quick to follow.

Zebra led the market with the first commercially available RFID smart label printer/encoder. Today, Zebra’s offerings include models to support low-volume and wristband RFID applications, as well as RFID print engines for print-and-apply systems, and multi-protocol UHF printer/encoders that support Electronic Product Code (EPC), Universal Product Code (UPC), and other tag protocols.

Businesses should actively seek to replace manual data collection activities with RFID and bar code systems whenever possible. Besides improving accuracy, RFID and bar code data collection is faster than manual collection, which improves labor productivity. Replacing paper forms with much smaller bar code labels and embedded RFID tags produces media savings that frequently reach six figures annually, even for companies with moderate levels of production tracking and shipping activity.

As customers flex their muscles to demand build-to-order and just-in-time deliveries from their suppliers—replacing the traditional build-to-stock model—traceability and data collection at the item level is critical. A relatively small investment in an RFID or bar code tracking system will ensure scheduling and materials applications will deliver benefits, leveraging the investment in those more expensive planning applications.

The figure below shows how achieving competitive advantage depends on an integrated system enabled through advanced data collection, automation, and traceability technologies.

![A System’s Technical Objectives](Diagram Source: The Rick Duris Unplugged Newsletter. Rick Duris. Rickdurisunplugged.com)
Efficient Receiving Applications

The receiving dock still represents one of the best opportunities to make major productivity improvements, even for companies that automated with scanning and electronic data interchange (EDI) more than a decade ago. New business processes can take advantage of existing technology systems to provide substantial savings at little or no incremental cost.

For example, longtime Zebra customer General Motors now requires its suppliers to label shipments with GM 1724-standard labels, which include two-dimensional (2-D) bar codes, instead of with AIAG-standard B10 labels, which do not. The new labels include all the information previously found in the B10 format, but the 2-D bar code provides additional capacity for new information for use by the producer, logistics provider, and GM.

Now, when workers scan a shipment on the GM receiving dock, in addition to recording the goods in the system, software directs workers to specific putaway locations, which may include direct delivery to the production line. This saves money by reducing materials storage space requirements and associated handling costs. GM expects to save millions of dollars per facility over time by improving the productivity of receiving workers and lowering raw materials inventory.

The additional data encoded in the labels also facilitates a higher level of lot tracking, which would enable recall of specific vehicles, saving millions in costs and damage to GM’s reputation from a general recall. Other manufacturers in many industries are instituting similar programs to take advantage of two-dimensional shipping labels.

The GM label standard is open and free to users. Zebra supports the GM program and additional 2-D initiatives from the American National Standards Institute (ANSI MH10), Air Transport Association (ATA), Electronics Industry Association (EIA), Telecommunications Industry Forum (TCIF), Uniform Code Council (UCC) and the U.S. DoD.

Companies may also conduct spot audits and quality checks on the receiving dock before accepting a shipment or releasing materials for putaway. In this application, a worker inspects items or sends the item to a testing station and record results in a mobile computer. A Zebra® mobile printer creates an RFID or bar code label to track the item through testing. Using mobile equipment on a wireless network, workers can ensure the right label affixes to the right item and can include variable information on the tracking label, such as the order number or time of delivery. Wireless-enabled mobile printers save labor time in this application because they save workers a wasteful trip to a central label location. One Zebra customer saved 182.5 labor hours per facility annually by using wireless printers.

Simplify Materials Management

Case or shipment labels may not provide enough tracking detail for managing goods once workers enter data into materials inventory, especially for companies that rely on inventory staging for effective workflow. With millions of parts to identify, locate, and move in and out of inventory, item-level and RFID bar coding is essential.

In the best-case scenario, the item’s inventory routing instructions are encoded and labeled at the receiving dock, as previously described. Once the item arrives at the warehouse, users can use a mobile device to scan the RFID or bar code label to record its arrival. The host materials control or warehouse management system (WMS) then directs the worker to the optimized putaway location based on the item’s size, shelf-life, and predicted consumption schedule. Workers then store the item and scan a separate shelf label to verify the item’s placement. Each scan leads the user to the next task and updates the host system.
If the inventory location information was not available for the incoming delivery when it first arrived at the loading
dock, it is a simple operation to print that label at the warehouse entrance. Here, companies typically rely on a
ruggedized RFID or bar code label printer that can withstand the rigors of an industrial environment.

After installing a system similar to the one just described, a baker and snack food producer with national
distribution reduced inventory and distribution costs 30 percent by gaining improved tracking over work-in-
process and finished goods inventory.

Streamline Production Line Applications

Most businesses apply RFID and bar code shipping labels when finished goods leave their facility. The most
efficient producers have learned that pushing their identification and tracking systems as far back into the
production process as possible provides tremendous labor and material savings.

The baker referenced above provides an excellent example. Its bar code system enables it to track raw ma-
terials through to finished goods. When the baker discovered one of its suppliers had provided a bad batch
of ingredients, the baker was able to determine the exact pallets that had affected products and the specific
stores that received the products. The baker then contacted its customers for a targeted recall, avoiding the
expense, embarrassment, and associated damage to its reputation that a general recall would have produced.
RFID and bar code-based production tracking systems can also automatically build audit trails and work
histories to support International Standards Organization (ISO) quality documentation requirements.

Lot tracking also enables companies to implement highly efficient lean manufacturing and business process man-
agement (BPM) initiatives. Encouraged by the success of Dell Computer and other make-to-order manufacturers,
many companies started initiatives allowing customers to custom configure their products, without special order
charges or longer lead times. These programs often rely on flexible manufacturing practices requiring frequent
production turns, new levels of work-in-process (WIP) tracking, plus more frequent, smaller shipments. Item-level
RFID and advanced bar code systems deliver the necessary functionality to meet these requirements.

RFID and Bar Code—Made-to-Order for Make-to-Order Manufacturing

Consider the business case of a leading computer manufacturer that uses several piggyback labels—smaller
labels that can be peeled off of a single backing—on its WIP tickets to custom label each sub-assembly with
matching serial numbers. Along the assembly line, users peel off the label related to their task from the WIP ticket
and adhere it to the part of the system that they put together, such as a hard drive, video card, power manager,
heat sink, etc. Besides ensuring that each computer receives the proper equipment, the matched item-level serialization helps the manufacturer with quality control measures by identifying each step of the assembly process.

There are numerous examples of how applying RFID tags and bar codes to work in process can drive automated
routing and assembly operations and provide valuable production tracking, even for small components that com-
panies often think of as untraceable. The application of this technology means that half-page work job tickets that
travel with items find replacement by tiny RFID tags or bar code labels placed directly on the item. Improved print
resolution, RFID encoding technologies, and the standardization of two-dimensional symbologies like Data Matrix
and UltraCode enable users to pack a significant amount of information—including lot codes, operator ID, and
time of production—onto components smaller than a postage stamp.
Consider a hypothetical company that identified three new production areas where it needed to provide WIP tracking to support its custom manufacturing initiative. The firm discovered two obstacles to creating traceability for materials in these production areas. First, the company had no way to access data from its materials planning system to provide the necessary information for its new WIP labels, because the software it used to create the RFID and bar codes was designed only to make shipping labels. Second, one of the desired labeling areas was chemical cleaning station in a corner of the factory that had no computer access. Once again, features only available in RFID and advanced bar code products could solve these problems.

Advanced label generation and management software uses open technology and supports certified interfaces to the most popular enterprise applications and platforms, including SAP® and select Oracle® applications, and any application that can support XML output. This enables printers to extract enterprise data on demand to produce labels without the time and expense of using middleware or developing custom interfaces.

Software solves the problem of printer data access. Wireless networking solves the problem of physical access. The latest Zebra RFID and bar code printers contain native wireless support, so they can be operable anywhere in a facility with a wireless network. Many legacy Zebra printers support wireless connectivity by installing the ZebraNet® Wireless Print Server. Zebra wireless print solutions can support multiple leading wireless networking technologies including 802.11b/g and related security protocols.

**Accurate Quality Control**

The same best practices and technologies used to track items through various production stages also apply to sample tracking and quality control. When detecting defects, item- or lot-level production visibility enables companies to minimize the number of items for scrap or rework, which can produce substantial labor and materials savings.

Until recently, circuit boards testing and verification had to wait until the end of the production line. Using this process, quality control agents could determine the specific production line, the assembly time, and the assembled components. The agent could even look down the line to see which employees assisted in the production.

The adoption of cleanroom production and wave soldering antiquated the above quality control process. In cleanroom settings, there is simply no room for a quality control station at the end of the line. Additionally, the testing equipment often violates the sterility of the cleanroom environment. The rapid pace of flow and wave soldering production means that the mere positioning of a quality control agent at the end of the process undermines the efficiency gained by the new technology.

Using an advanced bar code print system, the board’s production history and test results can be encoded and printed in a 2-D bar code (Data Matrix symbology is commonly used in the electronics industry) and applied to the board for lifetime tracking. High-resolution printers (usually 600 dpi or greater) are able to compress the required information into a tiny bar code with flawless scanning accuracy.

RFID smart labels offer an even more complete solution. Text and bar code data on the label is static, but the RFID chip is rewritable. Users could use a bar code to provide item-tracking information, and store production and testing data within the RFID chip, adding new information at each workstation. The entire production life of the component or assembly—from sub-component procurement to production quality control—now becomes accessible with a single scan. The tracking label can also include customized graphics and logos with razor sharp clarity.
**Improve Staging and Shipping**

Shipping operations benefit from using the same equipment currently used to produce shipping labels by modifying the system to take advantage of improved production tracking procedures. When production lots or specific items afford traceability through manufacturing, ERP systems can associate them with a specific customer order—a requirement in build-to-order environments.

A plastics supplier to the automotive industry changed its labeling system to create shipping labels at the time of production, instead of the picking time for shipping. This seemingly small change immediately removed a consistent bottleneck in its order fulfillment operations that frequently threatened to delay customer deliveries. The new labeling system also automatically provided data the company used to prepare EDI advance ship notices (ASNs). Thus, the company improved customer service while reducing the labor required for preparing shipments.

The system also enables updating CRM systems in real-time, so service representatives may promptly and accurately answer customer inquiries. Increasingly, companies are placing their order shipment information on a self-service Web site for their customers to access.

Each day thousands of outgoing shipments include an RFID or bar coded compliance label mandated by the customer. Shipments identified with smart labels bearing traditional label data in text and bar codes enables unattended, non line-of-sight identification, verification, and sorting at different points in the supply chain. Doing so brings full supply chain visibility to the enterprise.

**Enhanced Value from Item-Level Tagging**

Until recently, most RFID tracking systems targeted traditional supply chain applications, such as pallet and case-level tracking. With source and item-level tagging, the tags originate farther back in manufacturing and reach all the way to the retail distribution center and the consumer. In this scenario, RFID tags affix directly to an item's packaging or the actual item.

Consider the following application. As the retailer receives products, an RFID reader automatically scans each item in the packing material, and updates the retailer’s computer system, which then verifies product type and quantity. For large retail chains, the information syncs up the parent office ERP system. Scanners in the store track the item's purchase, or if the item leaves the store without the shopper paying for it. The enhanced visibility allows a store chain to reduce stock-outs and increase sales.

For manufacturers and food service enterprises, item-level tagging allows compliance initiatives driven by requirements to protect the food and drug supply and reduce counterfeit drugs. This also creates an opportunity for suppliers and retailers alike to optimize their processes in many ways. Businesses gain cost containment, operational efficiency, improved inventory accuracy, and a method to achieve compliance mandates.

**Remote Printer Management for Enterprise-Wide Tasks**

When companies use advanced applications such as those described in this paper, RFID and bar code printer/encoders become mission-critical components of their operations. Printing and tracking technology embeds into production and supply chain processes, turning any printing disruptions into business disruptions. Another emerging application—remote printer management—improves printer uptime and reliability.
The ZebraLink™ remote printer management tool lets system administrators perform diagnostics, resolve error messages, and check the status of networked printers without physically visiting the devices, even from different facilities. For example, if a printer runs out of bar code labels or RFID media, it can send a text alert to an operator or administrator.

People can launch print jobs from a smart phone, PC, mobile computer, organizer, or pager on a network. Administrators may also use their devices to proactively check on printers to monitor media use, performance, workload, and other factors. Many alert messages can be resolved through the ZebraLink connection without the administrator ever visiting the printer. These advanced control features maximize uptime and performance, lowering the total cost of ownership of the print system. For more information about ZebraLink tools, visit www.zebra.com.

Conclusion

RFID and bar code systems provide a high return-on-investment by reducing data entry and processing time, improving quality, and boosting the real-time performance of enterprise software applications. Information today is a valued component of all manufacturing, distribution, and retail operations, thus presenting a form of currency in many business relationships. Companies that can document the product lifecycle and tracing history to the item level—while meeting industry and other regulatory mandates—can win substantial new business and build strong customer loyalty.

Zebra Technologies Corporation (NASDAQ: ZBRA) provides the broadest range of innovative technology solutions to identify, track, manage, and optimize the deployment of critical assets for improved business efficiency. Zebra’s core technologies include reliable on-demand printer and state-of-the-art software and hardware solutions. By enabling improvements in sourcing, visibility, security and accuracy, Zebra helps its customers to put the right asset in the right place at the right time. Zebra operates in over 100 countries and serves more than 90 percent of Fortune 500 companies worldwide. For more information about Zebra’s solutions visit www.zebra.com.