



A Zebra Technologies White Paper

How Bar Codes and RFID Deliver Value to Manufacturing and Distribution



Precise Information Tracking—Vital for Lean Processes

Manufacturers depend on a well-coordinated chain of events to make their operations work effectively. In addition, mail order fulfillment and distribution companies unable to provide information with their products increasingly find themselves at a disadvantage versus their competitors. Today's business software packages, such as enterprise resource planning (ERP), materials management, production control, and supply chain visibility applications depend on real-time data collection and identification systems to provide information crucial for optimizing processes, productivity, and profits.

As more companies turn to enterprise-wide software for process improvement and cost reduction, there is a significant opportunity to enhance these systems by adding bar coding and radio frequency identification (RFID) applications throughout manufacturing facilities and distribution operations.

This paper shows how advanced bar code and RFID technologies can create sustainable advantages by providing the accurate information required for modern business practices. By implementing bar coding and RFID, companies can realize significant return on investment (ROI).

Benefits of Bar Coding and RFID

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 is within the supply chain at any point in time—is a high priority initiative within the industry. This could include a finished product, 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 with improved information reduces storage space and labor costs, expands asset utilization, increases inventory turns, enables faster billing cycles, and significantly contributes to cash flow.

Bar codes endure as the most widely used, cost-efficient, and effective tools for providing accurate data to company systems. Scanning 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, or, worse yet, manual record keeping with pencils and forms. For companies with ERP systems, which reuse the same data for many different applications, inadvertent transcription errors on the floor can cause major problems later in inventory, planning, and customer order tracking systems.

RFID is an automatic identification technology that relies on radio frequency (RF) waves to read encoded digital data. RFID is similar to bar code technology in concept. Unlike a bar code, RFID does not require a visible tag or label to read its stored data.

Consider the following benefits of bar coding and RFID:

- Promotes known inventory and item location at all times, reducing product search time, improving inventory stocks, and enhancing manufacturing process control.
- Helps enhance compliance, improve work-in process (WIP) productivity, and reduce finished goods cost.
- Enables real-time monitoring of production, order fulfillment, and distribution processes and their level of efficiency; aids in moving product profitably and quickly to meet demand and reduce inventory costs; and reduces labor costs by eliminating manual steps.

- Increases order and shipping accuracy. Helps ensure that orders ship complete, error-free, and on time, thus improving customer satisfaction.
- Promotes real-time data capture via warehouse management systems (WMS) and enterprise resource planning (ERP) systems.

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

Front-to-Back Improvements in Manufacturing and Distribution Operations

With on-demand printing solutions such as those offered by Zebra Technologies, fulfillment, distribution, and manufacturing operations can print labels precisely where and when they are needed—which is a real time saver if labels are currently batch-printed on or off site. Thermal printing saves money, reduces label waste, and improves bar code scannability compared with laser, ink jet, or line-based printing.

Compliance Labeling is Now a Requirement

Ever since the Wrigley Company put a Universal Product Code (UPC) label on a pack of gum, bar codes have been a key component of the industry. Manufacturers often design shipping labels to meet the needs of their customers. Many organizations in all business sectors, including Wal-Mart, General Motors, Boeing, the U.S. Department of Defense, and various regulatory and safety bodies require compliance labels on all incoming packaging. In addition, many compliance programs now require two-dimensional (2-D) bar code symbols or RFID tags. Other compliance programs require permanent identification for parts, components and finished products for traceability and product genealogy applications. These programs are most prevalent in the aerospace, automotive, defense, and electronics industries.

Compliance labels and tags present key benefits to a manufacturing facility such as timely and accurate data collection. Bar code and RFID labels provide serial numbers and other important product information that various production, inventory, and shipping systems can use to improve efficiency. Bar code and RFID readers and data collection terminals quickly, accurately, and automatically capture this information and communicate with a computer host that processes the data.

Improve Receiving Dock Productivity

The receiving dock represents one of the best opportunities to make major productivity improvements through bar coding. Typically, workers scan shipping labels on the receiving dock to record incoming goods into the company's system. Unfortunately, shipping labels often lack sufficient tracking detail for managing goods after inventory entry. With millions of items to identify, locate, and move in and out of inventory, bar coding presents essential benefits.

For example, raw materials or sub-assemblies arriving at a manufacturer's receiving dock include ID labels on their packaging to meet the company's requirements for materials management. Otherwise, the receiving department logs in the item and typically generates a 4-by-6-inch or smaller bar code label to identify the material before transferring it to an inventory location or inspection station. Workers create these labels with either an industrial thermal printer at the receiving area, or a mobile printer mounted on a lift truck or worn on a shoulder strap.

Remote printing at receiving and other areas throughout the facility enhances productivity by saving workers from having to travel to central locations to pick up labels. Decentralized printers can link to manufacturing systems and other enterprise applications through a variety of networking techniques, including secure IEEE 802.11-standard wireless links.

Order fulfillment and distribution operations that do not use bar coding technology frequently overstock inventory to avoid disappointing customers. In manufacturing operations, receiving departments often overstock raw materials to avoid disrupting production. With bar coding and RFID technology, enterprises can track inventories accurately—from all points of the supply chain to customer delivery—thereby achieving visibility while reducing the need for carrying excess items. By scanning bar code labels and RFID, recording item arrival, and precisely tracking item locations, businesses can realize tremendous savings in materials, labor, and overhead.

Balance Raw Material Inventories

At the front end of the manufacturing process, a warehouse operator transfers raw materials from the receiving dock to an inventory location. Bar code location codes printed on reflective labels identify the sites. Reflective material allows readability from scanners up to 30 feet away. Bar codes and RFID provide accuracy because the operator scans both the package and the new storage location to complete the transfer operation, which automatically updates the data in the ERP system.

Zebra's wide variety of bar code label printers and supplies helps deliver the advantages of bar coding throughout receiving and inventory operations:

- Mobile printers offer freedom of movement to bring bar code label printing directly to multiple points of application. For tracking applications in materials management, Zebra's wireless, mobile printers provide options for printing product identification labels or updating warehouse shelf labels on demand. Zebra's extra-rugged models, for instance, offer flexible connectivity options, including Bluetooth® technology and 802.11b/g.
- Stationed at the dock or warehouse entrance, high-performance and industrial/commercial printers are suitable for printing product identification labels. Zebra's rugged industrial/commercial and high-performance printers can withstand high-traffic environments and are network-ready.
- The wide array of genuine Zebra™ supplies includes warehouse shelf labels in reflective materials, thus allowing workers to read bar codes in upper racks from the floor.

Simplify Picking Tasks

Picking operations retrieve raw materials or parts from inventory as triggered by work orders from the factory floor. Mobile computers direct workers using fork trucks, carts, or just walking the aisles to the exact inventory location and identify the material quantity. Workers then scan the bar code to complete the transfer operation. Operations can identify reusable totes and containers used for picking and material handling with permanent bar code or RFID labels for automatic tracking. In situations where inventory labels require updates or replacement, secure wireless mobile printers mounted to lift trucks help simplify the task.

Pickers who do not work from vehicles often use mobile or cart-mounted printers to produce labels on demand. RFID tags allow both reading and writing, so workers can update tag data without generating a new label. Departments often use this feature to encode reusable totes with a tracking number that associates the tote with the specific fill order.

Success Story: Bar Codes in Action

To provide an example of the efficiencies generated through a bar code-based system, consider a distribution center that was previously losing valuable time in its picking operations. To fill an order, the forklift driver received a printed pick list from the shipping office, and then drove through the distribution center to pick up the listed pallets. After completing the task, the driver returned to the shipping office to pick up the required shipping labels based on the number of cartons on each pallet.

Solving the above challenge prompted the distribution center to implement bar coding that helped automate the pick list creation, ensure picking accuracy, and prepare items for shipping. Forklift-mounted Zebra® mobile printers enable the forklift driver to print on-demand shipping labels—saving the trip back to the shipping office.

Each forklift is now equipped with a small LCD screen that displays the pick list items in an order that optimizes the path to order fulfillment. The screen updates continuously from the company's enterprise-wide wireless network. For each item, the driver scans the product and the shelf label, communicating the selection to the network. If it is the correct item, the network automatically sends a confirmation that appears on the LCD screen and sends the shipping label information to the Zebra printer, thus ensuring that the label is the right match for the picked item.

The introduction of bar coding cut picking time in half, and helped achieve nearly 100 percent picking accuracy. The application improved efficiency to the extent that it even saves mileage on the forklifts, enabling the company to extend the life of its costly vehicles. As workers pick and place items into a carton, they scan the product identification bar code to report their removal from inventory and record the transfer to the order fulfillment/packing department. The printer creates a "license plate" (a unique, serialized bar code label), which is applied to the carton, identifying the order.

Streamline Work-in-Process (WIP)

Next, workers check the picked materials to verify the parts and quantities by scanning the bar codes on each item. During assembly, bar code or RFID labels enable part tracking throughout the process, showing the usage in an assembly, or if the part was set aside due to a defect or other issue. As parts become assemblies, production staff can add additional bar code labels to identify and track the assembly by its new part number, or update the RFID label.

Bar codes and RFID labels produced on durable and specialized media enable automatic material identification and tracking within tough production environments. Thermal printers support media that can withstand heat treatment and other temperature extremes, exposure to chemicals, cleaners and solvents, UV light, abrasion, and humidity and condensation, and can meet stringent clean room and electrostatic discharge (ESD) requirements. Businesses often use RFID in environments where optical identification of bar codes is impossible because of low light, no visibility, or other conditions.

In some process manufacturing, bar code and RFID labels identify transitions between lots or batches. For example, in paper, film, or coatings manufacturing, splices can be required between batches used to complete a master roll of material. The bar code label identifies the splice point with the time and batch number of the new material.

Enhance Product Identification Accuracy

Thermal transfer printing is widely used to print nameplate identification labels on-demand with serial number information and/or UL/CSA regulatory content. Synthetic label materials ensure the durability of the

image and the label's longevity. Most products and components that require a UID two-dimensional bar code to comply with U.S. Department of Defense lifetime identification requirements can use thermal transfer printers and media for labeling. Thermal transfer printing also meets many lifetime marking requirements in the aerospace, automotive, electronics and other industries.

For electrical products, labels with UL/CSA logos or content are unique because only specific label supplies tested by UL or CSA receive approval. Zebra offers hundreds of tested, UL/CSA-approved label and ribbon combinations for this purpose. Pre-approved label and ribbon combinations from Zebra can save manufacturers extensive paperwork and product delays when they need a new type of label, or one for a new application.

Complete Packing and Finished Goods Faster

At packaged assembly completion in discrete manufacturing, or product packaging in process manufacturing, bar codes identify the package contents. If no sales order for the product exists, the forklift operator collects the package and takes it to a finished goods warehouse location for inventory. Workers scan bar codes both on the product and at the warehouse location to complete the transfer operation.

In traditional systems, warehouse associates might travel the floor looking for items according to paper picking lists printed on large laser printers. In modern, automated systems using bar coding and RFID, upon order placement, the system notifies employees on mobile computer terminals. A customer sales order signals the picking operation to retrieve the product from finished goods inventory.

Drawing from item-placement data scanned during inventory putaway, the main computer system generates a pick list and displays it on the terminal with exact directions and location information. Scanned bar codes or RFID tags confirm the picking of the correct item, and records the transfer to the shipping department.

In the order fulfillment/packing area, the workers scan the serialized bar code label and upload the data to the main system. The system retrieves the order data and transmits a packing slip format to a wide-label thermal printer. Zebra's wide-label high-performance printer, for example, can print an 8.5-inch (215 mm)-wide packing-slip/invoice/return-label combination on-demand for insertion before the carton is filled with packing material and sealed.

Success Story: RFID in Action

Campbell Hausfeld, a leading manufacturer of home improvement and automotive tools, improved distribution speed and accuracy using Zebra's RFID printers and supplies. The company had difficulty tracking production of finished goods, and tracking the shipment of those products from its distribution facilities—resulting in inventory inaccuracy and discrepancies between production and distribution. This inefficient process forced employees to scan each pallet manually that came off the line for accurate reporting of production rates.

Once deployed, the RFID system benefited Campbell with significant time savings. All products receive an RFID label created from a Zebra printer. When workers place products on a conveyor, an RFID reader tracks each item. In 10 seconds, employees can perform the same task that previously took up to four minutes. In addition, operations can print long plays (LPs) in bulk, instead of printing the same label 15 or 20 times, thus saving more time. In addition to numerous operational benefits, Campbell realized significant labor cost savings, as well as an 80 percent decrease in error rates.

Fulfill and Track Shipping Orders

In order fulfillment and shipping, workers scan the serialized bar code label or RFID label on the packed carton to acknowledge receipt and verify the order's identity. A printer creates a 4" x 6" (102 mm x 152 mm) shipping label. Workers scan the shipping label to verify label application and that the information ties to the order data transmitted originally at receiving. This confirms the shipping of an accurate and complete order. Throughout the shipping route, workers can scan the bar coded shipping label as the package transfers to a truck, plane, or delivery van, thus aiding in fast, accurate delivery tracking.

If multiple labeled packages are combined on a pallet and shrink-wrapped, a larger, master label is often required for the pallet. Paper labels remain the choice for these applications, but businesses should specify synthetic master labels if the shrink-wrapping is recyclable. Other regulatory or environmental requirements may affect the label format, content or label materials.

The U.S. Department of Transportation (DOT) and National Fire Protection Association (NFPA) specify mandatory regulations for labeling of chemical packaging and containers used in transportation. Although many of these labels contain static information, on-demand, thermal-transfer printing onto preprinted label materials can provide a substantial cost savings by reducing the storage of expensive label inventory and waste that occurs when adhesive backings degrade.

Compliance formats may include 2-D symbologies such as PDF417 found in the GM 1724 label standard series, or Maxicode symbology for UPS shipping labels. RFID compliance labels also have a bar code component.

Zebra offers a variety of printer solutions that provide the 4-inch print width needed for shipping labels:

- High-speed, automated print-and-apply applications increase efficiency in the shipping area. A printer/applicator featuring Zebra's mission-critical OEM print engine, which offers a choice of left- or right-hand orientation and choice of print resolution, automatically applies the printed label to the carton. Operations can use Zebra software to centrally monitor and control these print engines in remote locations.
- For high-output address and shipping label printing in high-traffic environments, shipping departments can rely on Zebra's durable, high-performance bar code printers, which offer solutions for centralized printer management.

Expand Customer Self-Service

By leveraging the accurate information captured through bar code technology, a company's system can automatically send notices via e-mail to customers, and place order shipment information on a self-service Web site to allow customers to check delivery status and tracking numbers. Keeping customers informed with efficient communications saves businesses money and helps build customer loyalty.

Labeling Relates to Manufacturing Trends

E-Commerce

The impact of e-commerce has reached far beyond consumers purchasing books and compact discs online. Business-to-business online purchasing now accounts for the bulk of e-commerce transactions, and is increasing. Today, instead of a small number of large, infrequent product shipments to a distributor, manufacturers often must drop-ship individual packages directly to the end-users. As a result, the number of shipments (and shipping labels) required rises dramatically, and so does the effectiveness of on-demand printing when compared to batch printing tasks.

JIT Operations

To reduce inventory levels and overall inventory carrying costs, resellers are pushing much of their earlier stocking levels of inventory back to the manufacturer and demanding faster response to their orders. Manufacturers are responding similarly with their parts suppliers. To avoid stock-outs or production downtime, manufacturers and other supply chain participants are investing heavily in methods that deliver inventory just in time (JIT)—the precise quantity of the specific product required, at precisely the time of need. With increased customization and make-to-order (MTO) requirements, many manufacturers also need to provide components just-in-sequence to support their customers' manufacturing processes. As a result, JIT systems rely on bar code and RFID reading and printing to track products accurately and in real time.

This improvement in tracking lowers economic order quantity (EOQ) requirements by notifying part suppliers earlier about inventory replenishment requirements (EOQ levels alert purchasing to reorder parts). The result is lower inventory carrying costs, higher inventory turnover rates, reduced misplaced inventory, and more room to manufacture product cost-effectively.

ERP and WMS Systems

Major manufacturers have implemented or at least initiated an ERP, warehouse management systems (WMS), or related software applications to manage their enterprise. These systems allow JIT purchasing to work by tracking process components throughout the supply chain. By knowing what the process requires by when, and what is available from where, the ERP system optimizes the timing and efficiency of the purchasing, production, and fulfillment components of its business.

This system investment completely depends on the ability to track each component part, subassembly, and finished product from the raw material supplier to the end-user. Data collection for each transaction is critical in providing the ERP system with continuous status updates. Likewise, the necessary data collection steps are not possible unless identification is provided for each component part, subassembly, and finished product. Automated data collection is the keystone of the ERP system. The result: both the parts labeling volume and the number of locations that perform bar code printing within a manufacturing plant increase.

During integration, middleware vendors specify the data collection and label printing hardware for the selected ERP solution. Thermal printing solutions that can interface directly with SAP®, Oracle®, and other enterprise software systems are often easier to integrate and maintain, and are more cost effective than systems that require middleware, print servers, or custom programming. Companies should also consider bar code label printers that offer upgradeability to support RFID tag encoding in the future, if they anticipate RFID compliance mandates.

Wireless Communication and Network Administration

Wireless communication in manufacturing continues to grow rapidly because it allows real-time data collection in remote areas of the plant. With wireless technology, label printers can operate on location, eliminating the need for an employee to run back and forth between a centrally located printer and the point requiring a label. For example, mobile printers with wireless capabilities attach to forklifts and provide on-demand printing whenever and wherever the task requires a label. Once completed, the information uploads immediately to the ERP system instead of synchronizing at a shift change. This increases productivity and reduces errors.

The growing use of networked printers with enterprise systems increases the importance of network administration. Managing the network by remotely configuring or monitoring printers, or updating label formats, is becoming increasingly valuable, especially as advancements in security evolve and network

administrators look to update their networked devices. Printers that automatically communicate situations requiring attention, such as the completion of a roll of labels or an error condition, improve uptime and are critical to efficient plant operation.

Global Supply Chains

With companies transacting business around the world, it is more important than ever to be able to identify parts, products, and pallets of goods—plus their ports of call—in different languages on the same label. Organizations that need to print shipping labels in multiple languages face the challenge of implementing costly custom output solutions, or to treat characters as graphics, which results in very slow label printing. Printer support for Unicode™ simplifies international character printing and eliminates many modification and support expenses. A Unicode-enabled printer can seamlessly output any language, with no need for an operator to select the language, font, codepage, or otherwise configure, or adjust the printer.

Thermal Printing Preferred for On-Demand Applications

Of all the methods available for printing bar codes, thermal technology is preferred for on-demand applications. Thermal, which includes direct thermal (ribbonless) and thermal transfer printing, consistently generates crisp, clear lines and spaces for the highest bar code read rates with today's scanning technologies. Unlike laser or dot matrix printing, which wears over time, thermal labels are long lasting, especially thermal transfer printing on specialized media. Thermal printing also is the best choice for immediate, on-demand printing. It is fast (up to 12 inches per second) and inexpensive, and offers the greatest flexibility for placing bar codes on different kinds of labels, or on products and packages of different sizes and shapes.

Optimize the Process While Driving Profits

Bar code and RFID systems provide unmatched ROI by reducing data entry and processing time, thus improving the data quality and the performance of business systems. As a result, enterprises can track items accurately and achieve supply chain visibility. Manufacturing operations can gain tighter process optimization. Mail order fulfillment companies and distribution centers can achieve greater accuracy, efficiency, and control, from receiving and inventory, to picking, shipping, and customer service. The bottom line results are clear—reduced costs, leaner production, and higher profitability.

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.

**CORPORATE HEADQUARTERS**

Zebra Technologies Corporation
475 Half Day Road,
Suite 500
Lincolnshire, IL 60069 USA
T: +1 847 634 6700
+1 800 268 1736
F: +1 847 913 8766

www.zebra.com

USA

Zebra Technologies Corporation
333 Corporate Woods Parkway
Vernon Hills, IL 60061-3109
U.S.A.
T: +1 847 793 2600 or
+1 800 423 0442
F: +1 847 913 8766

LATIN AMERICA

Zebra Technologies International, LLC
9800 NW 41st Street,
Suite 200
Doral, FL 33178 USA
T: +1 305 558 8470
F: +1 305 558 8485

EMEA

Zebra Technologies Europe Limited
Dukes Meadow
Millboard Road
Bourne End
Buckinghamshire SL8 5XF, UK
T: +44 (0)1628 556000
F: +44 (0)1628 556001

ASIA-PACIFIC

Zebra Technologies Asia Pacific, LLC
120 Robinson Road
#06-01 Parakou Building
Singapore 068913
T: +65 6858 0722
F: +65 6885 0838

OTHER LOCATIONS

USA
California, Georgia, Rhode Island,
Texas, Wisconsin

EUROPE

France, Germany, Italy,
Netherlands, Poland, Spain, Sweden

ASIA-PACIFIC

Australia, China, India, Japan,
South Korea

LATIN AMERICA

Argentina, Brazil, Florida (USA),
Mexico

AFRICA/MIDDLE EAST

Russia, South Africa, United Arab
Emirates

Copyrights

©2010 ZIH Corp. Zebra and the Zebra head graphic are registered trademarks of ZIH Corp. All rights reserved. SAP is the trademark or registered trademark of SAP AG in Germany and in several other countries. Oracle is a registered trademark of Oracle Corporation and/or its affiliates. Unicode is a trademark of Unicode, Inc. All other trademarks are the property of their respective owners.

P1026566 (4/10)