ZEBRA TECHNOLOGIES

A Zebra Technologies White Paper

Increasing Profits and Productivity: Bar Coding and RFID Enables Precise Asset Management

Executive Summary

When businesses cannot locate tools and equipment at the time of need, the price is more than just inconvenience. Time spent searching for assets hurts productivity, reducing profitability. Workers lose the equivalent of one full 40-hour workweek per year if they spend only 10 minutes a day searching for and gathering needed items. The inability to track equipment location, usage, service, and maintenance records causes companies to lose money on lease and service agreements. Holding excessive assets ties up capital, which every business seeks to avoid. To improve competitiveness and profitability, enterprises must manage assets with the same care and innovation they use to drive excess inventory and costs out of operations. A good asset management program will improve return-on-assets (ROA) and other metrics by helping to lower and control the overall cost to do business.

Automatic identification and data collection (AIDC) technologies and techniques that already demonstrate their value improving supply chain visibility are easily adaptable to help optimize asset levels. Bar code and radio frequency identification (RFID) technology can make it simple and convenient to gather and manage asset information in a timely and efficient manner. These technologies can record asset movements automatically, and provide real-time data to asset management applications. Computerized systems provide current, accurate data that enables an organization to manage its assets with precise information instead of physical inventory. The result is a lower overall asset base, improved asset utilization, increased productivity and more efficient purchasing and maintenance—all contributing to bottom line improvement. These outcomes provide a sustainable improvement in profitability without burdening employees with excessive controls or reporting responsibilities.

Solving the challenge calls for convenient and consistent asset tracking. To show how, this white paper will:

- Describe how bar coding and RFID enables improved asset management procedures.
- Document how these technologies provide a return on investment (ROI) by saving time and improving accuracy.
- Provide examples of successful systems.
- Outline technology requirements and selection criteria.

Asset Management is a Key Component of Process Optimization

Effective asset management ensures employees always have equipment, tools, and other resources when and where they need them. Businesses can accomplish this task either by tightly controlling assets through meticulous record keeping and control procedures, or by purchasing and maintaining spare materials to provide sufficient safety stocks. Case studies prove that it is much more cost effective to ensure asset availability by managing information instead of physical goods. Doing so relies on consistent data collection and is vulnerable to human error or indifference. If information is inaccurate or out of date, assets will unexpectedly be out of service, leading to costly productivity and replacement losses.

When employees search for tools, test equipment, or supplies, the distraction may seem like an insignificant part of the workday, but the cumulative effect on productivity is significant. According to a 2003 survey by WhereNet (a wireless asset management systems vendor that has since been acquired as part of Zebra Enterprise Solutions), 64 percent of companies reported that their operations personnel perform at least one search for assets or inventory every day, and nearly half (47 percent) reported their searches take up to

one hour. Let's suppose, then, that a company's workers spend the conservative figure of 10 minutes a day searching for and gathering needed items. They would lose the equivalent of one full 40-hour workweek per year. To visualize if ineffective asset management is a mere inconvenience or a drain on profitability, consider the example below.

Dollar Cost of Asset Searches

Minutes/day spent on searches per employee:	10
Multiplied by 5 days a week for 48 work-weeks per year:	240
	2400 minutes per year/60 minutes
= Search time spent per year	40 hours per year
Search time spent per year multiplied by average hourly pay rate	40 hours x $25
= Search time expenses by employee	$1000 per employee

The analysis multiplies the number of workers who look for items in the course of their work by their average weekly salary. To see the cumulative drain on expenses in a business, multiply the total search time expense by the number of employees at that salary level engaged in the same activity.

Lost assets are an even larger drain on profitability, as the following scenario illustrates. Assume that a maintenance worker has a week of vacation coming up and plans to do several home improvement projects. Without asking or notifying anyone, the employee "borrows" a cordless drill valued at $60 at the last day prior to vacation.

The following week another employee needs to use a drill, but cannot find one. The employee, who earns $18 per hour, spends 10 minutes thoroughly searching the tool crib, then looks for the drill in other areas around the facility. After a half hour of fruitless searching, the employee notifies a supervisor. The supervisor (who earns $30/hour) makes a cursory 10-minute search of the area, declares the drill lost, and authorizes an asset replacement. If the company had already deployed an automated asset management system, the "borrowed" tool scenario never could occur. Consider the cost of this single incident:

Employee search time:	$9 (0.5 hour @ $18/hour)
Supervisor search time:	$5 (0.17 hour @ $30/hour)
Item replacement cost:	$60
Total:	$74

If the company earns the S&P 500 average after-tax profit margin of 10.72 percent, it needs to bring in $690.30 of new revenue to replace the $60 drill. If the supervisor sends the employee to the hardware store to buy a new drill and the trip takes an hour, the required revenue climbs to $858. In addition, the task the employee originally needed the drill for misses the scheduled deadline. Once the new drill arrives, the company will have an extra drill when the first employee returns from vacation, which represents excess capital equipment and lower asset utilization.

Incidents like the drill example occur undetected daily in the business world, robbing companies of productivity and profitability. Even though shareholders and executive management do not pay attention to cordless drills, they pay close attention to the return on assets (ROA) the company earns. With competition and the economy making it difficult to acquire new revenue, companies have renewed their focus on ROA and aggressively seek to improve it through increased outsourcing, equipment leasing, and supply chain management activity. A good asset management program improves ROA and other metrics by helping to lower and control the enterprise cost structure.

The Solution: Use Bar Code and RFID for Asset Management

The first step to any asset management program is to identify and record (inventory) all assets. This initial step may be very time consuming, but businesses must accomplish the task in detail to provide an accurate foundation that enables future improvements. Identifying and recording all assets provides a snapshot that gives the organization an accurate view of its assets for a specific period. For asset management to be effective, organizations need to create and use consistent processes to record changes in asset location, condition, and availability. Bar code and RFID simplify the recording process and help ensure the entry of accurate information.

Kitsap County, Washington, operates an automated system for tracking road signs that provides an excellent example of the time savings and accuracy benefits of bar coding. After changing data recording procedures from a manual, clipboard-based process to a bar code scanning process, the county reduced data entry time by 92 percent and improved the accuracy of information in its database.

The county records the location, condition, age and other data for each of its 18,000 road and street signs. Employees label each sign with an 11-digit serial number that includes both printed text and a bar code. The serial number uses a schema that uniquely identifies the sign and describes its location. Whenever there is action performed on the sign, such as new placement, removal for repair, application of new coating or other maintenance, employees automatically record the serial number and activity into the county's database application.

Road crews previously recorded serial numbers and activity in the field with pencil and clipboard and submitted the paperwork to a traffic engineer at the end of the day for manual entry into the database. The redundant manual data recording procedures provided two opportunities to incorrectly log or transcribe the serial number. Studies on data input accuracy conducted in the bar code industry found that an experienced typist makes one error approximately every 300 keystrokes. Using this standard benchmark, Kitsap County would make approximately one error per every 27 database entries—which does not include errors resulting from incorrect serial number recording in the field, where weather conditions and other distractions can lead to more errors.

Kitsap County now records data in the field by scanning the bar code with a handheld computer and key entering a 2-character activity code. At the end of the day, employees place the computers in docking cradles at the office and all the work activity records upload automatically to the county computers. Traffic engineers previously spent at least three hours a week entering handwritten report data; the process now takes about three minutes a night. Bar code scanning also saves considerable data entry time in the field, enabling road crews to service more signs each day, and has improved data entry accuracy at both ends of the process.

Kitsap County's success is a classic example of the benefits automatic identification and data capture can provide for asset management. In addition, business and governmental departments can use automatic identification and data capture (AIDC) technologies to identify all types of assets in many environments

including large, immobile highway signs, expensive test equipment and tools, computers, peripherals and digital cameras, even replacement toner cartridges and other supplies. The following sections describe how to take advantage of bar code and RFID technology to meet different asset management needs.

Tracking Fixed Assets

Kitsap County operates a traditional bar code asset management program that is notable because the assets are always outdoors. Durable bar code labels and rugged scanners make the system possible. Enterprises often use bar codes and RFID for in-premise asset management programs to identify all sorts of fixed assets and capital goods, from PCs, to office furniture, to material handling equipment.

Asset management programs vary, and depend on the frequency that the business desires to track the materials, and the amount of information that the program records. For example, a company might check a conference room table every few years with a simple location audit. The same company might monitor the usage, maintenance and performance issues of important production equipment every shift. Regardless of the audit frequency or data content, automated data entry delivers real benefits because it collects information faster and more accurately than manual methods.

Beyond scanning fixed assets annually for inventory, audit or insurance purposes, organizations can expand their asset management programs to collect additional information. Monitoring assets regularly, performed efficiently with automatic identification, can improve asset utilization and the total cost of ownership by providing the information needed to optimize capacity planning and preventive maintenance.

Bar code and RFID can play an important role in these applications. For example, consider a cutting machine that requires oiling and other periodic maintenance based on hours of use or the type of jobs processed. Traditional asset management would probably require verification of the machine's location and condition once a year—a requirement easily met with a simple bar code scan. By creating procedures that require workers and maintenance personnel to record the amount of time they used the machine and any maintenance performed, the company can build a service record that supports the asset record. Departments can collect the additional data by scanning the asset label and scanning or key entering a job code, similar to the Kitsap County system. Collecting data regularly provides invaluable information for risk management and defending against liability claims.

Businesses that use heavy equipment can bar code supplies such as oil and replacement parts. Employees can scan the assets as they load the machine. Scanning automatically associates specific materials and quantities with specific machines. Database and maintenance management applications can use the information to monitor asset efficiency, schedule preventive maintenance, or send alert messages if the machine uses an inordinate amount of supplies that may indicate a performance problem. The documentation also supports service agreement and warranty claims.

For maintenance operations, departments can use an RFID tag to identify the equipment and date of installation, and then update the tag whenever employees perform service or inspection tasks. Workers who service the machine could read the tag to learn the most recent work performed or service history, which is extremely advantageous for remote asset management where personnel may not have access to enterprise databases and service records.

Service documentation and record keeping can have a direct effect on profitability. Businesses that show leadership in automating their service operations are significantly more profitable. Manufacturers who provide equipment service to their customers fail to capture the majority of service revenues because of

poor record keeping and management. When businesses use automatic identification to capture information that builds service records and deploy mobile printers to create service reminder labels and other materials, the results are better service efficiency and lower costs. Doing so also uniquely positions the enterprise to gain additional service revenue.

Tracking Moveable Assets

Businesses can use bar code and RFID systems to track tools, equipment, and other moveable assets. In addition, mobile data collection equipment or automated dispensing machines can automatically record asset movements.

Automated dispensing machines function like vending machines for tools and supplies. Employees present their ID cards (usually sporting a bar code or RFID tags for automated processing) to the machine, which reads the badge automatically to identify employees and verify their authorization to receive the requested equipment. When releasing equipment, the machine records the item serial number (often by a bar code scan) and stores it in a record with the date and time of release and which employee received the equipment. The system tracks each item disbursement objectively with no human data entry required. Bar code scanners can log materials back into the system, which automatically applies a time and date stamp to the transaction documenting their return.

Diverse Asset Tracking Opportunities

Tool crib, depot, storehouse, library, and other operations provide similar asset management opportunities. For example, employees can scan out their own items, or the organization can use a material clerk in place of the dispensing machine. Creating supermarket-style equipment checkout operations enables organizations to manage more assets than dispensing machines, which can hold items of limited sizes and quantities. However, self-checkout and clerk-checkout operations are not as accurate because they rely on users to scan both their ID and each item every time.

Moveable assets, which include files and samples in addition to tools and equipment, often receive tracking with mobile data collection equipment. The asset database and other desired data or usage rules are loaded into a mobile computer, which may be a handheld, laptop, tablet, or vehicle-mounted model. A bar code or RFID reader can be added as a peripheral device or integrated into the computer to automatically identify items in the field.

Asset Tracking in the Hospitality Industry

Many casinos use handheld computers with bar code readers to automatically identify collection boxes as they are removed from slot machines. Slot machines are highly regulated and casinos must be able to provide specific collection and payout information for each machine or risk losing their license. Managing cash boxes and machines requires total data entry accuracy and can be very labor intensive and time consuming without bar coding.

Systems integration firm Mpact developed a casino asset identification system featuring handheld computers, bar code scanners and Zebra® label printers that significantly streamline slot machine cash management. Collection employees use a handheld computer with bar code reader to scan both the slot machine asset ID label and the separate cash box label when employees remove boxes for collection. Application software uses the scan data to build a database record associating the box with the machine. Because boxes are automatically associated with the correct slot machine, they can be unloaded and processed in any order in the count room.

Prior to cash counting, employees scan boxes once more, which triggers the automatic generation of a label that has the box ID printed in text and bar code. The label scan occurs when counting machines process the cash from the boxes. System software links the scanned ID with the cash machine count to automatically create the collection record for each slot. The casino can then circulate the empty boxes again and do not have to match the box to specific slot machines. In this scenario, the system cut container tracking time in half at some casinos in addition to improving accuracy and compliance and saving time in counting operations.

Asset Tracking in the Medical Industry

Businesses in the healthcare and medical industries face daunting challenges when tracking equipment and ensuring compliance with surgical cleanliness mandates. Timely asset management of sterilized surgical instrumentation is a complex and laborious task. Traditionally, the management of instruments requires the application of numerical pre-printed tracking labels and the manual recording of the label numbers by hospital staff. While this provides minimal instrument set traceability, there is no real-time view of the inventory, resulting in instruments being "lost" in the system.

Over the past few years, new diseases and the requirement for hospitals to identify and keep detailed records of which instruments staff use on specific patients have made detailed asset management a priority. In 2009, St. George's Healthcare NHS Trust in the UK started an equipment modernization program that included an instrument management system. At the point of packing, unique instruments are permanently marked and a thermal transfer printer creates a two-dimensional (2-D) bar code tracking label. During each stage in the instrument process, automated readers scan the tracking label. As a result, the location of the tray, and the instruments within it by association, automatically update within the instrument management system.

As a result, St. George's now has true real-time visibility into its surgical instrument inventory. The ability to track assets, the interfacing of the instrument management system with the hospital information system, the linking of instruments to patients, and the subsequent instantaneous retrieval of data help ensure the delivery of safer patient care. Download the complete case study from www.zebra.com.

Precise Pallet Traceability

Consider the merits of asset tracking in the warehouse and distribution industry. Using automatic identification systems to track pallets, racks, trays and other returnable containers within a facility can provide a strong return on investment by lowering operating expenses. Many companies do not have accurate information about the quantity and location of their shipping containers because the assets often remain at other facilities and are not returned promptly. As a result, businesses purchase more returnable containers to ensure they have an adequate supply, creating excess capacity and locking capital into fixed assets.

Identifying returnable containers and tracking them provides the information businesses need to improve returns and recoveries. To do so, businesses must permanently identify each asset with an RFID tag encoded with a company-specific ID number and/or a standardized Global Returnable Asset Identifier (GRAI) code. Departments can automatically identify containers each time the container exits or enters a facility, with the transaction time stamped, using unattended RFID portals, forklift-mounted readers, or handhelds. Workers can use mobile readers in the field to record container drop offs and pickups. By leveraging business database systems, departments can associate containers with customer records, providing detailed visibility and billing data.

Consider iGPS, a pallet-pooling company founded in 2006. Employees include RFID tags on all of the returnable plastic pallets the company has in circulation. Every rented pallet from iGPS contains RFID technology to maintain tracking. The pallet pool self-reconciles. RFID technology tracks each asset transparently in real time, eliminating disputes and errors. iGPS also credits its RFID tracking system with preventing lost

pallets, streamlining asset and inventory management, and aiding Sarbanes-Oxley (SOX) compliance by providing documentation on assets.

Identification Options

Regardless of the environment, asset management begins with uniquely identifying each asset. This concept is easy to understand but is often challenging to execute. Kitsap County, discussed earlier, conducted testing for more than six months before it was satisfied that it found a label material that would remain affixed to signs and ensure bar code readability during a lifetime of outdoor use. Lab applications often involve exposure to temperature extremes and harsh chemicals. Industrial equipment can frequently accumulate dirt and grease, making bar codes unreadable.

Finding the optimal way to identify assets is a three-step process. First, determine how much information the asset identifier must contain. The identifier is usually a serial number, but it could also contain configuration or service data. The choice of data content will dictate the second decision, which is to choose a data carrier. Data carrier refers to the method the data will be expressed. It may be in text, a traditional bar code, 2-D bar code, or an RFID tag. After determining the data carrier, choose which label material will perform best in the expected usage environment.

Determining Content

Asset tags do not need to carry actual data, but must clearly and uniquely identify each asset. The most common situation is to use the asset tag as a serial number that corresponds to a record in a database that stores the actual asset information. The license plate on a vehicle is a good example. Vanity plates notwithstanding, no one, including law enforcement officers, can determine an identity simply by reading a license plate. Law enforcement uses the plates to learn the identity and relevant driving history from a database they access by radioing to the station, or by using a wireless computer in the field. In the business world, users may conduct database lookups through a wireless or wired LAN connection, or by accessing files stored on a mobile computer. Because databases can hold more information than license plates or other common identifiers, lookup architectures are favored for most asset management applications.

Each industry specifies its own compliance and marking requirements. Asset management programs cannot use the U.P.C./EAN bar codes applied to most consumer products. U.P.C./EAN numbers identify the product and its manufacturer, but do not uniquely identify each individual item. This is not a problem for inventory operations, where quantity is the chief concern, but is problematic for permanent asset management when service, maintenance, and warranty history require tracking for each item. For asset tracking, businesses can leverage the EPC Tag Encoding scheme version 1.3 for Serialized Global Trade Item Number (SGTIN-96). This scheme permits the direct embedding of U.P.C./EAN standard GTIN and 38-bit serial number codes on EPC tags.

Businesses can design asset identification systems to include some intelligence to streamline operations or enable work to continue if database access is unavailable. For example, Kitsap County's 11-digit serial numbering system for signs includes:

- A five-digit road identification code.
- A four-digit mile code that describes the sign's road location.
- A digit to indicate which side of the road the sign belongs on.
- A sequence number that differentiates each sign if crews post multiple signs at the same location.

A database on the handheld computer carried into the field contains the road identification codes, so crews only need to scan the sign codes to retrieve all the information they need to locate and place road signs.

Data Carrier Selection

Most industrial, lab, and office asset management programs have sufficient database access to use simple serial numbers for bar code identification. Employees can access database records through a wired or wireless connection to a host computer, or stored in a mobile device. If database records are too large or access is unavailable, additional information must be included in the asset label. The primary options are to encode a 2-D bar code or an RFID smart label.

Two-dimensional symbologies encode data both horizontally and vertically (hence the name 2-D) and can hold much more data than traditional linear symbols of the same size. One symbology enables the encoding of the entire Gettysburg Address in a space slightly larger than a standard linear U.P.C./EAN symbol. Other symbologies allow the printing of a serial number, lot code and production date so small that the information can on tiny parts and electronic components.

RFID wirelessly reads data from smart labels. In addition to being able to hold more data than linear bar codes (currently up to 2000 bits), scanners can read smart labels even if they are covered in dirt, grease or other contaminants and do not require a direct line of site between the label and reader. Read/write RFID tags are available, which businesses can update with usage, inspection, service or other data in the field using a mobile read/write device. For more information about smart labels, visit www.rfid.zebra.com.

Selecting the Right Technology

The desired data carrier and the environmental conditions (temperature extremes, sunlight, dirt, chemicals, and moisture) determine the range of acceptable label materials. The label must identify the item from the time employees place it into service until the time it is retired, so the label requires durable materials and permanent adhesives.

Many document printers require an entire sheet of label material to produce each label, and cannot apply different information to multiple labels on the same sheet. These printers add unnecessary cost to labeling operations because the process wastes so much material. Thermal transfer printers can accept the widest variety of label materials of any on-demand print technology and are purpose-built to provide the best bar code print quality. Thermal transfer printers also produce labels with sequential serial numbers or other variable data on demand, with no wasted label material.

Thermal transfer printers can produce long-lasting bar codes and smart labels on paper, polyester, polypropylene, and other synthetic materials that resist temperature extremes, condensation and moisture, blood, oils and chemicals and other contaminants. Zebra Technologies offers multiple media and ribbon combinations certified to meet UL and CSA marking requirements. Thermal printing is the only technology that currently enables the on-demand printing and encoding of smart labels. Media efficiency is one of several total cost of ownership (TCO) advantages thermal provides over other print technologies.

Pulling it all Together

Precise asset management helps eliminate the need for businesses to maintain excessive assets, frees up capital, and helps control the overall cost to do business. A complete asset management system requires several key components:

- Bar code and radio frequency identification (RFID) printer/encoders, readers, and where to locate them to achieve best value and productivity
- System level network, host computer, and integration software that links the disparate printer/encoders, readers, and network
- Application software that filters, analyzes, and presents the data so managers can make critical decisions about where, how, and when to leverage, replace, or reallocate business assets, fixed or mobile

Precise Asset Tracking Helps Streamline the Enterprise

Effective asset management requires timely, accurate information. Gathering the information must be convenient. Otherwise, operators will tend to skip the step, thus compromising data integrity. Even the temporary unavailability of low-value items can have a surprising impact on a company's productivity and profitability. Therefore, once an asset management program is established, organizations should seek to include as many assets as possible in the program to maximize the system's ROI.

On-demand thermal bar code printers and smart label printer/encoders make it convenient and cost effective to label all types of assets for automatic identification at the point of consumption or application. They produce durable labels that will help provide the accurate information foundation that successful asset management programs require.

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.

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