Productivity Through Portability:
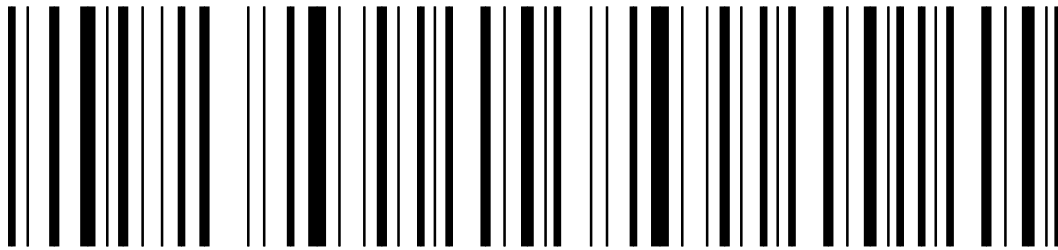# Mobile Printing Delivers
ROI in the Warehouse

APPLICATION WHITE PAPER

Zebra

Zebra Technologies

Executive Summary

Bar coding is indispensable in warehouses and distribution centers to maintain accuracy and efficiency. These benefits can be enhanced by using mobile printers to produce and apply bar code labels at the point of application. Supplementing stationary bar code printing operations with mobile printers can reduce operator errors, the inefficiencies associated with labeling in inconvenient locations, and added costs associated with correcting errors.

Using mobile printers to eliminate the distance that workers travel to pick up labels can produce powerful productivity gains, often providing a full return on investment in less than a year when used in warehouse, distribution center and other industrial environments. The ROI is especially strong for facilities with existing wireless LANs, because a relatively small incremental investment in mobile printers creates new ways to increase efficiency, reduce operator errors and leverage the wireless infrastructure investment.

This white paper will show you where it makes sense to supplement bar code labeling operations with mobile printers by:

- Identifying common operating procedures in warehouses and distribution centers that can be improved by mobile printing;

- Illustrating how common operator labeling errors can be prevented by printing at the point of activity;

- Providing real-world examples of how mobile printing systems have improved operations;

- Presenting formulas and guidance for creating a return-on-investment calculation;

- Describing how mobile printers can be integrated with wireless LANs and batch operating systems;

- Presenting an overview of mobile printing technology and capabilities.

Introduction

The case for using mobile printers becomes stronger with every step users must take to pick up labels. Zebra Technologies conducted a time-motion study of receiving operations, in which the warehouse worker only had to take nine steps to travel from the pallet with items to be labeled to the workstation where labels were printed. Pallets were labeled in 42 percent less time (28.11 seconds compared to 49.74) when belt-worn mobile printers were used to eliminate the short walk to the central printing station. Based on the volume of materials processed at that particular distribution center, managers quickly determined that a mobile printing system would provide significant productivity gains and a rapid return on investment.

Here is the actual worksheet the organization used to measure and compare the labor costs required for labeling with stationary and mobile printers. You can add your own numbers to calculate the potential savings mobile printing could provide your operations.

Mobile Printer Cost-Benefit Analysis

Example Data:	Fixed Printers	Mobile Printers	Annual Saving
number of shifts per week	10	10	
number of hours per shift	8	8	
number of weeks worked per year	48	48	
number of hours worked per year	**3,840**	**3,840**	
average number of items labeled per hour	15	15	
average time spent getting labels (minutes)	2	0.5	
number of hours getting labels per year	**1,920**	**480**	**1,440**
average labor cost per hour (euros)	12	12	
cost of getting labels per year (euros)	**23,040**	**5,760**	**17,280**

Eliminating wasteful trips also eliminates a potential source of distractions that can lead to labeling errors. Concentration shifts each time a worker leaves the task at hand. Walking through the aisles creates ample opportunities to become engaged with other work-related tasks or to chat with co-workers. Each delay increases the likelihood that the worker will pick up the wrong batch of labels from the printing station, (or make a data entry error if the worker is printing the labels) and that labels will be applied to the wrong item.

These are simple mistakes that may be regarded as business as usual. Many businesses with bar code control systems boast inventory accuracy of 99 percent or more. Driving inventory accuracy or warehousing efficiency to this level usually provides dramatic improvements over previous procedures, so the one percent error rate is often very acceptable to users.

However, there is still tremendous value in developing new procedures featuring mobile printers to further improve accuracy rates. Today most companies have inventory control systems that efficiently manage inventory. However these systems are only as accurate as the data entered into them. Inventory accuracy is critical to having the proper inventory at the right time. Increasing safety stock to make up for poor accuracy leads to lower inventory turns and negatively impacts return on assets. Mobile printers provide a mechanism for warehouse personnel to cycle count as their in aisles, improving real-time inventory accuracy.

Other forms of accuracy problems, such as shipping the wrong item or quantity, or shipping cartons to the wrong customer, also create hidden expenses that undermine profitability. For example, 2.5 percent is considered a typical error rate for warehousing operations, and various studies have determined that shipping errors cost a company between $60 and $250. The cost of errors varies by the expense of shipping replacement orders, warehouse labor and handling expenses, sales and customer service time spent on error resolution, and other factors. At the standard error rate of 2.5 percent and an error cost of $60, a company loses $150 for every 100 orders processed. If errors cost $250 to resolve, the error cost per 100 orders jumps to $625.

Consider a company that ships 100 orders a day, has an error rate of 2.5 percent, and spends an average of $100 to resolve each error. Errors cost the company $250 per day. If the company has a five-day work week and operates 52 weeks a year the errors cost $65,000 annually. A one percent improvement in the error rate, from 2.5 percent to 1.5 percent, would save $41,600 error-related expenses annually. If the company has a profit margin of 5 percent, it needs to bring in $1.3 million in revenue just to offset the cost of errors if the error rate is 2.5 percent ($65,000 annual error cost ÷ .05 profit = $1.3 million).

The following section describes how mobile printers can support common warehouse processes to reduce these types of problems.

Applications

The timesavings and labeling accuracy benefits that mobile printers provide can be applied to many common warehouse processes, including receiving, quality assurance, cross docking, putaway, picking, packaging and shipping. Mobile printers can go wherever workers go, and into some places where tabletop and industrial label printers cannot. Work areas that require the farthest travel to get labels, or operations that could benefit from improved accuracy, are the best candidates to support with mobile printing. Here are some ways the technology can support typical warehouse operations.

Receiving

It is common practice for organizations to print batches of labels for incoming goods at a central IT office after receiving an advance ship notice (ASN) from a supplier. The labels are stored in the office and retrieved by a receiving worker when the shipment arrives. This process requires the receiving worker to make a time-consuming round trip between the dock and the office, and creates the possibility that the wrong labels will be applied to the shipment.

Eliminating this process is a major way mobile printers can produce productivity gains and accuracy improvements. Forklift-mounted mobile printers can be used to apply bar code labels on incoming materials immediately as they are unloaded. This procedure ensures items are prepared for scanning and other automated processing systems in place at the facility. Labeling items at the receiving area also ensures that 100 percent of incoming materials are bar coded, so that bar code-based check-in, putaway, conveyor and other automated applications are fully leveraged and can provide maximum benefits.

Large, bulky items and cargo containers can even be received and labeled in the receiving yard or other outdoor locations, because mobile printers are available for indoor and outdoor use. The Military Traffic Management Command (MTMC), a branch of the U.S. Department of Defense responsible for managing port operations, uses mobile printers to help process tanks, trucks and other military cargo that is loaded and unloaded from ships. The printers are used to create documentation, create tracking labels for unmarked items and to print replacements for damaged or incorrect labels on the cargo. The MTMC previously printed all labels in a central office at each port, so the switch to mobile printers has produced tremendous timesavings because workers no longer have to leave the dock and make the long trip to the office.

Quality Assurance

Inspectors can take advantage of mobile printers to create clear, legible labels to identify samples taken for quality assurance. Items pulled from incoming shipments or from inventory could be tagged with a tracking label to route the sample through testing and to serve as a work order indicating the tests to be performed. Quality assurance workers could also use mobile printers to clearly identify samples with "pass," "rework" or "reject" labels. Using a mobile printer would virtually eliminate the chance that items would be misidentified— thereby avoiding quality problems.

Cross Docking

Cross docking is used to save time in receiving and redistribution, so mobile printing is made to order for this environment because it saves steps for receiving personnel. Shipping and receiving workers equipped with mobile computers, bar code scanners and label printers can receive inbound shipments, log them into the host warehouse or inventory control system with the mobile computer, then use the mobile printer to immediately generate a bar code shipping label with the required cross dock information. Point-of-activity labeling provides the accuracy needed to process fast-moving items, without adding delays.

Putaway

The company that conducted the time-motion study for receiving operations described in the Introduction also labels items in the warehouse aisles immediately before they are put into storage. Items labeled at putaway were processed 62 percent faster when operations were supported with mobile printers compared to when workers picked up labels from a stationary printer that was only one aisle away from the putaway location.

The company put these data points into its cost justification worksheet and determined it would receive a full return on investment in less than a year by using mobile printers to supplement its putaway and receiving operations. Workers now initiate label requests by entering information into a handheld computer. The data is transmitted instantly to the company's enterprise resource planning (ERP) system over an 802.11b-standard wireless LAN that covers the facility. The ERP system receives the transmission, updates inventory records and returns the information required to produce the bar code label. The system saves an average of 30 minutes per day per user.

Mobile printers can also be used with wireless-directed putaway operations. By receiving real-time updates of forklift locations and transaction activity, warehouse management system (WMS) software can balance workloads, calculate the most efficient putaway route for each forklift driver and communicate instructions in real-time to a mobile computer on the vehicle. Route efficiency gets even more of a boost when mobile printers are used so drivers don't have to be frequently directed past stationary print locations.

Picking

Picking works like putaway in reverse, and holds the same time-saving potential. Wireless LAN and on-board printing are especially valuable because they enable operators to pick multiple orders simultaneously within a small zone, which reduces empty travel time and raises productivity. Mobile printers are used to generate bar code labels for each item that can be scanned in the staging or packaging areas to expedite the sorting of items for specific shipments.

A Midwestern distribution center implemented a wireless LAN to communicate picking instructions directly to its forklift drivers and eliminate pick lists. The new process eliminated the need for drivers to periodically go to the office to receive their pick lists saving time on their route, allowing for more customers to be serviced.

Drivers now pick orders per the receiving instructions on the screen and scan each item's bar code label and shelf location label when the item is picked. The scanned data is sent over the wireless LAN to the server, which confirms that the correct item has been picked. The host application then formats a bar coded shipping label for the item and sends the print job to a mobile printer mounted on the forklift. Picking time has been cut in half and accuracy has increased to nearly 100 percent since the system was implemented.

The wireless picking application described above is fairly typical, and so are the benefits. Combining real-time communication with bar code control prevents errors without slowing the user down.

Finished Goods Packaging

Mobile printing is useful in warehouses and distribution centers where kitting or light assembly takes place, or where items are placed into packaging. When assembly or packaging is complete, the worker can immediately generate a label to identify the finished good. The label could have a serial number or two-dimensional bar code that has the specific configuration information for the item. This application is important for maintaining accuracy, because many unique items may look alike and could easily be mislabeled if the worker had to leave the work area to pick up a batch of labels. Scanning the bar code label prior to placing the item into finished goods inventory to ensures the storage location is recorded accurately, thus preventing picking errors for look-alike items.

Ship to Order

A similar application can be used to manage ship-to-order operations. Rather than identifying and labeling final assemblies, bar code labeling and scanning are used to verify that all the items required to complete the order have been picked and packed.

Items can be labeled with an order code when they are picked, or at a packing area to associate them with specific orders. Prior to shipping, a worker in the packaging or shipping department scans the bar code label on each item and system software alerts the operator if any items are missing or duplicated. When the final order was assembled or complete, the worker would generate a shipping label with a mobile printer. This application ensures that the correct items are packed into an order and that the order is identified with the proper shipping label.

Technology

Mobile printing is adaptable to numerous applications because mobile printers have been designed to integrate into industrial business processes and information systems. Mobile printers are almost always used with mobile computers and have the communications interfaces and mounting options necessary to ensure convenient operation.

Wireless Options

Wireless technology gives mobile printers the flexibility to be integrated into a variety of processes and information systems. Printers can use wireless technology to connect directly to enterprise wireless LANs, or to the mobile computer. Different types of wireless technologies are used for each method and are described below.

Networking
Mobile printers can use a wireless network connection to receive print jobs, label formats, variable data and other information from host systems. The printer has an IP address and appears like any other device on the network, which lets users take advantage of the many third-party software products available for network management and security. Wireless network printing is possible even if the mobile computer used with the printer does not have a wireless network connection.

Warehouse management systems and other enterprise applications can take advantage of existing wireless networks to direct mobile printing operations. Organizations that already have wireless LANs for warehouse management systems or other enterprise applications can integrate wireless printers without having to develop special interfaces.

Zebra supports multiple security and networking protocols from leading vendors, to make it easy to add mobile printers to your network.

Cable Replacement

Infrared (IR) light or radio frequency (RF) can be used for wireless communication between the mobile computer and printer. A wireless configuration frees an interface port on the mobile computer for use by other peripherals. Mobile computers with two radios can do wireless networking and wireless printer communications without interference. A wireless printer interface improves worker safety and convenience because there is no cable to tangle. There are also no cables to repair or replace, which can provide a significant cost benefit over the life of the system.

Under most normal usage conditions, cables will need repair or replacement long before the printer reaches its end of life. Connectors are especially prone to weakening and failure. Solution providers often specify custom cables designed for the specific models or mobile printer and computer to minimize strain on the connectors. The additional cost for custom cables plus normal repair and replacement expenses can easily exceed the cost of a wireless interface, which will last the lifetime of the printer.

Workers try to adjust and fix aging cables before turning them in for repair or replacement, which causes distractions and lost productivity. A retailer that uses mobile printers for in-store operations studied its employees and found that each mobile worker spent an average of two minutes a day on cable-related tasks. If the same amount of time was required in warehouse operations, a warehouse with eight mobile workers would lost 16 minutes a day, or 1.33 hours per week, in productivity due to cable-related issues. A wireless interface could eliminate this drain on productivity, which is another example of the incremental benefits that wireless mobile printing systems can provide.

Infrared was the first technology used for wireless printer communications and was very popular, but increasingly is passed over in favor of Bluetooth. Bluetooth® is emerging as the leading wireless technology to replace cables. Bluetooth is a standardized, short-range wireless technology that enables up to eight computers, printers, and other devices to interface with each other. Bluetooth communication works up to 30 feet (9 m) without going through a centralized hub or server. Bluetooth provides fast and reliable printing. Because Bluetooth operates via radio frequency it isn't affected by light, does not require line of sight, and it is immune to physical sources of interference.

Zebra Wireless Options

Zebra Technologies supports all the wireless technologies described above. For maximum flexibility, Zebra offers QuickLink™ removable radio modules for its QL and QL Plus series' of mobile printers. QuickLink radios come in Bluetooth and 802.11b. For more information about wireless technology, see the Zebra white paper *The Benefits of Wireless Printing*.

The variety of radio technologies and designs makes it easy to add wireless printing to most information systems. Wireless connectivity provides many safety, convenience and productivity advantages. Other printer characteristics, including design, power supply and supported media, are also important parts of the user experience that directly impact the productivity and accuracy improvements that mobile printing will have on operations. These factors are briefly described below.

Printer Design

Mobile printers used in warehouses are usually worn on a belt or shoulder strap, or mounted on a forklift or cart. Other options include small label printers that connect to hand-held computers to form an all-in-one unit, and desktop or industrial label printers that are mounted on carts. Size and weight are the most obvious and easily understood design characteristics but may not be the most important, especially if the printer is mounted on a vehicle or carried on a strap. Features like the size and location of displays, position and style of controls and accessibility to media can have much more impact on productivity than size or weight. Mobile printing should provide convenience, and the benefits to implementing a mobile printing system will be reduced if the printers are awkward to use.

Application testing by the user will reveal a lot about which design features are important and the suitability of specific printer models for the operation. Testing and evaluation should reveal how cables are stressed and if they get in the user's way during normal activity. If warehouse workers wear gloves, be sure to determine if printers can be operated easily with the gloves on. In cold-storage warehouses or other facilities where equipment is subject to extreme temperature changes, test to ensure that condensation does not make display screens unreadable, and that temperature conditions do not effect print quality and label media performance.

Media

Resistance to moisture and temperature ranges in addition to many other factors, should be considered when identifying a warehouse's media specifications. Media must be matched to the specific model of printer and the usage environment to ensure optimal performance for the label material itself and for the printer. Media optimized for the printer requires less battery power for printing, and also extends the life of the thermal printhead. Additionally, appropriate levels of adhesive ensure that the label will adhere for the length of time desired, and excess adhesive won't clog the printhead.

Most mobile printers use direct-thermal media, which is also used by most stationary printers in warehouses to create picking and putaway labels. Mobile printers used in warehouses accept a variety of label, tag and ticket stock to produce shipping labels and other types of bar code identification that retain quality and readability through all storage, handling and supply chain operations.

Power Management

How the printer manages its power supply is important to overall battery life and application effectiveness. Print volume, label size, the amount of wireless transactions and other factors all affect how long batteries last before needing to be recharged or replaced. As a minimum requirement, look for printers with power management allowing batteries to last a full shift during peak busy times. The amount of time required for recharging may be important if mobile printers will be used in multiple or consecutive shifts.

Users should test their applications to ensure that the batteries they use consistently perform as needed and will not contribute hidden expenses to the total cost of ownership. For example, nickel metal-hydride (NiMH) batteries have a higher initial cost than nickel cadmium (NiCAD) products, but have less performance degradation over time, are more efficient at holding their charge, and have a longer life span. Lithium-ion (Li-Ion) cells represent the latest in mobile battery technology. Though more expensive than either nickel cadmium or nickel metal-hydride cells, lithium-ion cells offer the highest power-to-volume and power-to-weight ratio of the three. For example, in a typical printer application, a lithium-ion battery pack producing 7.2 volts has 30 percent more power than a nickel metal-hydride pack, with half the volume and half the weight.

Some mobile printers have adapters so they can be powered from vehicle batteries. A variety of battery chargers are also available.

Conclusion

Mobile printing is an option to make select warehouse labeling operations more convenient, improve productivity and reduce labeling errors. Supplementing enterprise printing operations with mobile printers may produce time savings that eliminate bottlenecks, or boost accuracy that results in better overall performance of warehouse management, shipping and other operations. The examples presented here have shown how saving a few steps, or improving upon already accurate identification and labeling procedures, can produce measurable cost savings and productivity gains. These improvements can be maximized by selecting products and features that best meet operational requirements.

Zebra Technologies is a pioneer in wireless printing technology and a leading provider of mobile printing solutions with thousands of successful installations in warehouses and distribution centers. We have a complete line of mobile printers, accessories and media to meet different application requirements, plus software and connectivity solutions for integrating with leading warehouse management, enterprise resource planning (ERP), database and networking environments. Visit our Web site, www.zebra.com, to see additional white papers on mobile and wireless printing technology, case studies, product information and other resources or contact us to learn more about our warehouse management solutions.

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