



Mobile Enterprise Solutions

W H I T E P A P E R

Using Data Collection Technologies to Increase Perfect Order Metrics

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Executive Summary

Companies are continually finding new ways to get the right goods to the right customers at the right time, and have developed many metrics to measure their performance in these areas. Most of these metrics show distribution productivity and accuracy are improving over time, which keeps raising the bar for service levels. For example, from 2007 to 2008, companies reduced their average days on hand of finished goods inventory from 35 days to 28, reduced dock-to-dock cycle time by 2.5 hours, and reduced days of sales outstanding from 40 days to 35, all while maintaining 98 percent fill rates, according to the Annual Warehouse Benchmarking studies conducted by the Warehouse Education and Research Council (WERC) and DC Velocity.¹

Customers demand continuous improvement, and markets reward it. In 2007 the 25 companies with the best supply chains (as measured by AMR Research) greatly outperformed the S&P 500, producing an average total return of 17.9 percent, compared to 3.5% for the S&P.² Companies with perfect order rates (a popular metric that measures customer orders that arrive complete, on time, undamaged, and with an accurate invoice) of 80 percent or higher are three times more profitable than companies with perfect order rates of 60 percent, a separate AMR Research study found.³ Better perfect order performance also correlates strongly to higher corporate earnings per share (EPS) and return on assets (ROA), the same study found. Figure 1 below highlights these findings.

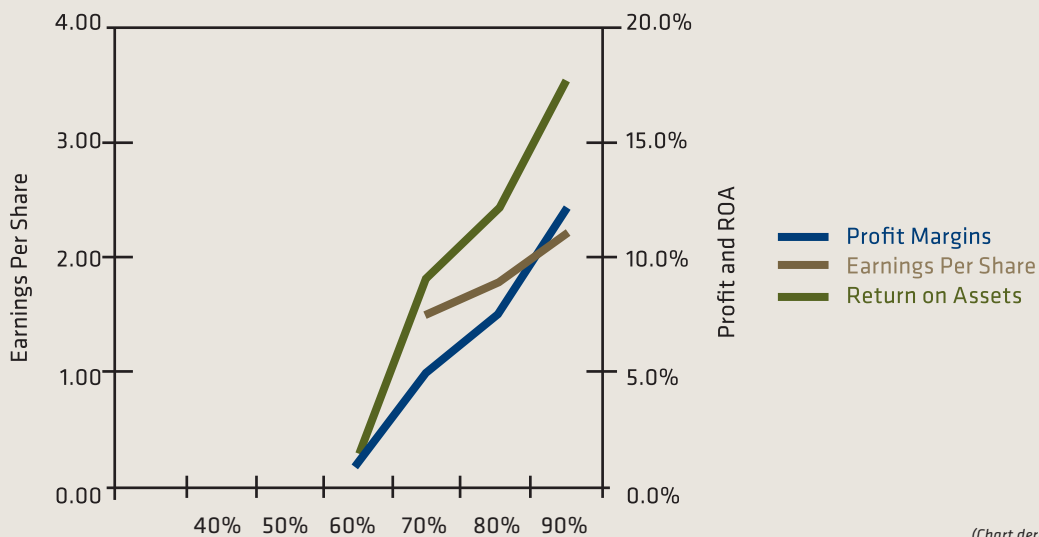
“Perfect Order” Defined

The Warehouse Education and Research Council (WERC) put forth a widely-accepted definition of what constitutes a perfect order. WERC defines a perfect order as:

- Complete
- Delivered on time
- Damage free
- Correct Documentation and Pricing/Invoicing

Perfect Order Index is a popular performance metric that is calculated by multiplying each of the four perfect order components.

Fig. 1: Correlation Between Perfect Orders and Profit Margins, EPS and Return on Assets



(Chart derived from AMR Research)

This white paper explains how each aspect of perfect order performance can be improved through enhancements to data collection processes and technologies. It does not focus on basic bar code-based shipping, receiving and inventory management applications, nor on warehouse management systems (WMS) or wireless-directed picking and putaway. Such systems are foundational to efficient, highly accurate warehouse and distribution operations. This white paper focuses on other technologies which will provide better execution and productivity to create a greater competitive advantage.

¹ Comparison of Annual Warehouse Benchmarking study data presented in Spring 2007 and Spring 2008 editions of “WERC Watch” published by the Warehouse Education Research Council (WERC).

² “AMR Research’s Supply Chain Top 25 Beats Market with 17.89% Return” AMR Research, January 10, 2008.

³ “AMR Benchmark Analytics” AMR Research, 2003-2004.

Introduction

Even if a company's fill rates, on-time delivery, damage-free shipment and accurate invoicing success rates are all very good -- say 95 percent -- its chances of providing a perfect order are not. Problems are prevalent even at these lofty levels of performance. A 95 percent success rate for each of the four perfect order components give companies only about a four out of five chance to complete a perfect order, as the following perfect order metric calculation developed by WERC shows:

- 95% fill rate (0.95) x 95% on-time deliveries x 95% damage-free shipments x 95% accurate invoices = 81.4% (which can be expressed as $0.95^4 = 81.4$).
- Companies that perform at 90 percent success levels for each component have less than a two out of three chance to make a perfect delivery ($0.9^4 = 65.6$).

To underscore this point, the following table highlights the findings of WERC's research into perfect order metrics at companies. It shows that 95 percent performance levels put companies at a competitive disadvantage, and that across-the-board success rates of at least 98 percent are required to gain an advantage.

Fig. 2: Select WERC Perfect Order Metric Data Warehouses are categorized from Major Opportunity to Best in Class.

Perfect Order Metrics	Major Opportunity	Disadvantage	Typical	Advantage	Best in Class	Median
Percent of orders with on time delivery	Less than 92%	>=92% and <95.8%	>=95.8% and <98%	>=98% and <99%	>=99%	97.5%
Percent of orders shipped complete	Less than 89.4%	>=89.4% and <96%	>=96% and <98.14%	>=98.14% and <99.5%	>=99.5%	98%
Percent of orders shipped damaged free (outbound)	Less than 98%	>=98% and <99%	>=99% and <99.08%	>=99.08% and <99.9%	>=99.9%	99%
Percent of orders sent with correct documentation	Less than 98.9%	>=98.9% and <99%	>=99% and <99.9%	>=99.9% and <100%	>=100%	99.5%

Table adapted from Warehouse Education and Research Council WERC Watch, Spring 2008.

Many companies have used a combination of automated material handling equipment, mobile and wireless computers, and automatic identification and data collection (AIDC) systems to improve their inventory accuracy rates to more than 95 percent. Today these accuracy and productivity levels often aren't enough to meet perfect order goals, or to provide competitive differentiation. Consider this finding from Warehouse Automation -- What's Really Working For Pallet, Case, and Piece-pick Operations? a research report from Aberdeen Consulting Group:

Increasingly, bar code scanning, which was for years the "gold standard" for pick accuracy, has a much less compelling correlation to Best in Class accuracy of 99% and above...Bar coding still correlates to success in all three categories [pallet, case and piece picking]. However, it is no longer a key differentiating technology that is only used by Best in Class companies. Bar-coding is now the Industry Norm, rather than technology that can give a company an "edge" over the competition.

Getting an edge doesn't have to involve major changes to systems. Some simple enhancements to legacy data collection systems can provide the improvement needed to consistently hit perfect order metric goals. Using bar code with other mobile, wireless and AIDC technologies has tremendous potential to improve order accuracy and on-time fulfillment, and can also play a surprising role in improving invoice accuracy and reducing problems from damaged shipments.

The following table highlights processes and enabling technologies that can improve accuracy and perfect-order performance. It shows that improving performance in one area may involve making changes beyond the process itself. The sections that follow explain and expand these concepts, with real-world examples from successful users.

Metric	Goals	Technology Enablers
On-time Delivery	Streamline receiving, put-away, and picking.	Integrated WMS, wireless computing to manage receiving put away and picking.
	Speed check-in, loading and check-out operations with automated documentation.	Advance shipping notices/Electronic Data Interchange (EDI) and mobile computers enables quick scan of barcodes and reduces time to receive load. Validate outbound shipments with barcoding and RFID.
	Reduce drive time and track shipments en-route	GPS and/or wide area wireless communications to redirect and track deliveries.
Complete Orders	Identify and record items as they are received.	Area imaging technology allows scanning barcodes at any orientation, from 6 to 50 inches away providing efficiency in the warehouse.
	Improve receiving and putaway	Use mobile printers to generate barcode labels right at receiving.
	Pick items accurately	Speech technology with mobile computing and barcode systems raises accuracy levels.
Damage-free Delivery	Provide documentation that goods were shipped and delivered damage free.	Mobile computers with integrated imager to take picture and show goods delivered damage free, also with signature capture for proof of delivery.
Accurate Invoicing and Documentation	Provide documentation information to customer	Advance shipping notices/ Electronic Data Interchange (EDI) provide documented information to destination receiving operations.
	Prevent customer invoice disputes.	On-site signature with mobile computers & on-site invoice generation with mobile printers.

Consider Multiple Ways to Improve Performance

To focus narrowly on the four components of the perfect order is to deny opportunities to improve the overall success rate. Improving perfect order rates requires improving processes that occur before items are aggregated into the order for shipment to the customer. Businesses can look as far back as their receiving operations to make changes that will improve perfect order performance. Aberdeen’s research confirms this opportunity:

To truly break through the 99% accuracy barrier, companies need to realize that accuracy starts with **putaway, returns processing and replenishment**—the right item must be placed in the bin location to be begin with to ensure that it is selected correctly later in the process.

Aberdeen Consulting Group

What’s Really Working For Pallet, Case, and Piece-pick Operations?

Warehouses and distribution centers are already so efficient and accurate that some of the best opportunities to increase perfect order shipment are closer to the receiving dock than the shipping dock. Specifically, one of the most promising ways to reduce shipping errors is to attack underlying inventory accuracy problems. The following sections illustrate how each element of perfect order performance can be improved through changes to supporting processes and technologies.

On-time Delivery

On-time delivery is the most widely used measure of distribution performance. It is also one of the easiest metrics to improve, because raising productivity in virtually any warehouse process will help get shipments out faster. Aberdeen Group's research found two areas in particular that correlate to strong on-time delivery performance:

Furthermore, automating put-away and returns processing is now the top predictor of excellence in On-Time Shipments. With faster order turn-around times, product often needs to be picked as soon as it is received. A fast and accurate system for getting that product to the right bin location can be a key factor in getting orders out the door on time.

Aberdeen Consulting Group

What's Really Working For Pallet, Case, and Piece-pick Operations?

On-time performance can also be improved with innovation at the shipping dock, which typically has room for improvement -- truck drivers spend as much as half of their on-duty time waiting at docks, according to a study produced by the Truckload Carriers Association (TCA) and Mercer Management Consulting. There is clear value in processes and technologies that speed check-in, loading and check-out operations.

Systems developed to streamline warehouse receiving and inventory management operations can be leveraged to improve operations at the dock door. For example, shipment verification applications can be set up to automatically generate the documentation needed to release the shipment. One way is to use the data captured automatically to validate items in the shipment to build bills of lading and to provide input for appropriate EDI messages. Such applications require no manual paperwork and data entry, which helps trucks get off the dock faster.

Another way to streamline loading and shipping operations is to upgrade the mobile computers used there to wireless models that support unified communication, which gives users walkie-talkie or push-to-talk capabilities. Real-time connectivity helps personnel quickly resolve issues that can cause shipping delays. En-route shipment tracking, using either GPS or mobile computers with wide-area wireless connectivity, can also help prevent delays, and enables dynamic rerouting to optimize delivery routes and schedules.

Complete Orders

Complete orders depend heavily on having items in stock, then storing, recording and picking them accurately. If goods aren't properly identified and recorded when they are received, there's no hope to keep inventory accurate and to attain error-free orders. Businesses can attain an advantage with several easily integrated enhancements to legacy bar code systems that are proven to improve accuracy and productivity. Enhanced bar code technology, changes to item labeling processes, speech input and radio frequency identification (RFID) have all been proven effective.

One way to improve accuracy is to reduce the amount of inbound materials that must be recorded and processed manually. Fortunately, most goods usually arrive at warehouses already labeled with a bar code, but the codes aren't always readable, leading to error-prone manual data entry. A simple upgrade in bar code scanning technology can reduce non-reads and misreads, and simultaneously improve accuracy and productivity. Options for upgrading scanning capability include imagers and next-generation laser scanners, both of which are widely available for use in handheld computers and as separate handheld scanners.

Another tactic that's been successful for improving receiving and putaway accuracy is to use mobile printers to generate bar code ID labels for incoming materials right at the receiving area. Having workers create and apply labels as goods are received reduces the chance of mislabeling, which often occurs when workers pick up batches of labels from a central printer then go to the receiving or putaway area to apply them. Eliminating the shuffle between stationary label printers and the items to be labeled also improves productivity.

Combining bar code data entry with speech input can raise accuracy levels even more significantly, especially for picking operations. There are different names that people will use when describing speech technology (for example, Aberdeen Group calls it "voice"). For the purpose of this paper we will use the term "speech systems" due to confusion with other "voice" systems like VoIP. Speech systems let workers keep their hands and eyes on the task at hand, rather than having to repeatedly switch from handling product to inputting data. Aberdeen's study found clear links between the use of speech technology, picking accuracy and best-in-class performance. The report states:

Voice-directed picking also showed a strong correlation with ultra-high accuracy rates. Companies with Best in Class pick accuracy were 22 percent more likely to be using voice.

Aberdeen Consulting Group

What's Really Working For Pallet, Case, and Piece-pick Operations?

The report also found companies that ranked as best-in-class for labor cost reduction were 56 percent more likely to use speech-directed picking than companies in general.

Speech systems have long been known for their accuracy and efficiency, but adoption has been somewhat limited because they have not always been easy to implement. That is changing with the emergence of open speech systems developed to integrate with legacy mobile computing and bar code systems. One example is terminal emulation (TE)-based speech recognition technology, which eliminates the need for a separate speech server and a proprietary interface between the speech system and the application software. By using terminal emulation to format and process speech input/output, data flows from and into existing software applications as if it had been entered by bar code scanning, key entry, or whatever method was previously used. TE-based speech recognition systems can work with warehouse management systems in real-time, which is another important innovation from traditional speech recognition technology. See Intermec's white paper *Talk to Your Warehouse: Speech Recognition Comes of Age* for more information.

Success Story: Speech Input Raises Accuracy

Lighthouse for the Blind, a non-profit organization in St. Louis that trains and employs non-sighted workers, improved its warehouse picking accuracy by 25 percent with a new speech recognition system. The innovative system includes audible confirmation of picked items, enabling blind workers to accurately pick orders.

Once item receiving, identification and picking are all accurate, the final step for preparing complete orders is to ensure all the right items are included in the shipment. One simple way is to scan individual bar code labels as items are packed, and integrating the operation so the order management system or WMS generates an alert if there are missing items or excess quantities. By using Serialized Global Trade Identification Numbers (SGTINs), errors can be detected and prevented because each specific case can be recognized with its own unique serial number. For example, if you have 10 cases, each one will have a unique number. Applications can take advantage of individual IDs to avoid accidentally counting the same case more than once, and to make sure there are the right amount of cases on the pallet. SGTINs can be encoded in bar codes or RFID tags. RFID is highly efficient for this operation because it can record goods automatically with no labor required. The process requires an RFID infrastructure, but adoption is growing. For example, look where large-scale early RFID adopters are deploying the technology -- it's usually at the receiving dock, where portals or forklift-mounted readers are used to accurately identify incoming goods in a fraction of the time it would take to scan the bar codes on each case and pallet.

Damage-free Delivery

How can mobile computers, wireless communication and automated data collection prevent goods from being damaged in transit? They can't. But they can clearly document that goods left the distribution center in good condition and were undamaged when they were signed for at delivery. Handheld computers with integrated imagers are increasingly being used for proof-of-delivery applications so

drivers can document the condition of goods delivered. Customers typically sign for the delivery on the computer's touchscreen, and the driver uses the imager to take a digital picture of the freight. The computer automatically applies a time and date stamp and appends the image to the transaction record, where it will be available to customer service and other personnel after uploading (which can be done in real time over a wide area wireless network).

Accurate Invoicing & Documentation

Most of the processes and systems described so far also support accurate invoicing. When organizations scan each item in a shipment to ensure a complete order, it's relatively easy to use the data to generate accurate invoice for only charging for items shipped. Scan data can also be used to automatically create advance shipment notices (ASNs), bills of lading and other documentation.

Another way to improve accuracy is to produce invoices at the customer site when deliveries are made. Companies can automate this process by having drivers review deliveries with the customer, record discrepancies or adjustments on the driver's mobile computer, and having the customer sign for delivery right on the computer screen. The driver can then use a mobile printer to create an accurate invoice on site. The up-to-date document should contain no surprises, which in turn should prevent customer disputes.

Success Story: Bar Coding Leads to More Than 99.9% Invoice Accuracy

CDS Logistics, a 3PL firm specializing in home delivery, provides a successful example of how systems can be leveraged to improve billing accuracy. The company automated its warehouse and delivery operations with automated applications based on handheld computers with integrated bar code readers. The system provided many inventory accuracy, damage reduction and labor productivity benefits. CDS Logistics also took the extra step of leveraging the data collection system by linking it to EDI, billing and other enterprise systems. Packing lists, EDI messages and invoices are created automatically, with invoice accuracy exceeding 99.9 percent.

"The new bar code system enables the CDS customer service department to bill for the exact number of cabinets delivered," said Steve Burgess, the firm's IT manager. "Today we need to research approximately .075 percent of our invoices, which is much better than the amount of research performed with the old system." (A complete case study CDS Logistics is available on Intermec's Web site.)

Conclusion

Perfect order is growing in use and importance as a metric for business performance. As the need to improve perfect orders rises, so does the need to upgrade legacy processes and systems. Common real-time bar code systems are often no longer enough to provide the accuracy and efficiency to create a competitive advantage or to reach target metrics. Blending legacy systems with complementary technologies such as enhanced scanning, digital imaging, mobile printing, speech input and RFID enables new processes that will help companies meet their perfect order goals.

With more than 18,000 warehouse solutions installed worldwide, Intermec's experience and track record in helping customers improve accuracy and customer satisfaction is unparalleled. Intermec technologies automate data input and validation to increase the number of "perfect orders", improve customer satisfaction, and reduce costs/write-offs associated with inventory shrink, invoice disputes and adjustments. We can improve your operations accuracy and performance by providing a broad range of solutions based on technologies and products that are most appropriate for your specific operations.

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