2-D bar codes and imaging scanners enable new functionality and benefits in tracking applications.

Bar Codes
Take On A New Dimension

The introduction of high-quality, low-cost image scanners has helped increase the utilization of 2-D bar codes. These price and performance improvements, along with mandates in a number of industries, have transformed 2-D bar code labeling and scanning from a niche application to a mainstream automatic identification technology.

Unlike linear (or 1-D) bar codes, which are made up of a series of black bars and white spaces, 2-D codes consist of more complex patterns that can store larger amounts of data. "This allows more information to move with the item through the supply chain, often eliminating the requirement to communicate to another database to access detailed information," says Michael Kapp, senior vice president of marketing at Compsee.

The ability to access detailed tracking data without online access to a database has made 2-D codes an attractive choice in manufacturing and maintenance applications, where parts can be labeled (or even directly marked) with these bar codes. "Because two-dimensional bar codes contain the data itself rather than acting as a lookup key, users in remote locations don't need to connect to centralized databases, thereby speeding up their activities and reducing any down-time caused by network issues," says Harry Lerner, CEO of Janam. "This increases productivity, improves accuracy, and lowers costs."

In addition to their increased data capacity, 2-D bar codes feature enhanced error correction, allowing them to be read even if the labels have been damaged or torn. The imaging scanners used to read 2-D codes also have several advantages over their laser counterparts, including omnidirectional scanning capabilities (which means the codes can be read regardless of the orientation of the scanner) and increased durability because imagers have no moving parts.

2-D Imaging Used In New Applications, Mandatory Programs

While many basic tracking applications are still well-served by traditional bar codes, 2-D codes are best suited for applications with more robust data requirements, or where end users may not always have access to an online database. The codes are also used to mark items that are too small for traditional bar code labels.

In healthcare, for example, patient wristbands, laboratory sample labels, and even surgical instruments have been marked with 2-D codes to provide highly detailed information (such as patient allergies or time/date stamps for lab samples) and ensure patient safety. Medical manufacturers are also utilizing 2-D codes for product labeling and production keys, which provide manufacturing instructions within the label.

FedEx, UPS, and the U.S. Postal Service use a variety of 2-D bar codes to track packages, and many states have added 2-D codes to their driver's licenses. Most airline boarding passes now include 2-D codes, and there are even applications available that allow the code to be scanned from the screen of a cellular phone rather than from a printed ticket.

"One of the reasons that 2-D technology will continue to explode in usage as the price point of 2-D-capable mobile computing hardware comes down is that

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Bill Roeder
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by Brian Albright

every customer wants to know more about what is moving through their enterprise and to do so without relying on occasionally spotty network connections," Lerner says. "The advantages that 2-D technology presents have universal appeal."

Several industries have also mandated the use of 2-D bar codes. The U.S. Department of Defense's Unique Identification (UID) initiative requires that suppliers mark high-value assets with Data Matrix codes, and the Air Transport Association's Spec2000 traceability standard includes 2-D bar codes. There are several initiatives underway in both Europe and the U.S. that would require 2-D bar codes to validate pharmaceutical authenticity. The Food & Drug Administration is also currently developing a UDI (unique device identifier) mandate for medical devices that will likely include 2-D bar codes, although the requirement isn't mandatory until 2013.

Driving 2-D use in retail is the looming adoption of new standards for marking fresh foods and coupons. International standards group GS1 introduced a 2-D code called DataBar several years ago to supplant the common UPC bar code in some applications. Starting in 2011, manufacturers will be able to print coupons using only the 2-D code (presently, many coupons contain both 2-D and linear bar codes); in 2014, GS1 is asking all retailers to be prepared to scan DataBar on loose produce and other items.

For companies affected by these mandates, it's important to not just deploy the technology in order to meet those requirements. Imaging and 2-D bar coding also provide business benefits that go beyond compliance. "The biggest challenge for any company facing a mandate or regulation is to avoid the pitfall of 'compliance for compliance's sake' — that is, spending resources to meet the letter of the law, without taking a step back to see how that law or mandate could potentially help the business long-term," says Bill Roeder, VP of marketing and business development at LXE.

Select Proper 2-D Printing, Imaging Equipment

The imaging scanners used to read 2-D bar codes have improved significantly over the past several years in terms of scan speed, motion tolerance, and read range, and now compare favorably in both price and performance with laser scanners. Most mobile computers that currently read linear bar codes can be upgraded to scan 2-D codes. All imagers are capable of scanning both linear and 2-D codes, and in some cases can be used as digital cameras. "End users need to understand that, just like any new technology, 2-D bar coding solutions keep getting better and better," Roeder says. "So if you evaluated a solution a year ago and it wasn't right for your application, keep checking it, because it may be the right solution now."

End users are often concerned with read range, motion issues, and lighting conditions, but modern imagers can typically address these issues. In order for these applications to work properly, though, end users have to invest in label printers and imagers that are capable of printing and reading high-density codes. "For example, a code that is 10 mil or higher density will require a high density imager as well as a bar code printer with a printhead resolution of 300 dpi or better to print the label," Kapp says. "If you do not take into account the density of your code when selecting equipment, you will have problems."

Not all imagers are created equally, so it's important to investigate the features and limitations of any device before making a large purchase. "The majority of imagers being deployed today still have a limited depth of field when compared to laser scan engines," says David Paufler, senior product manager at Datalogic Mobile. "This limitation means that the end user may need to experiment to find the best read range for capturing a particular code. With time, the user will intuitively know the approximate distance needed to obtain consistent good reads on the first attempt."

Put imagers through a rigorous testing process before deployment to ensure that an imaging solution will provide adequate operational improvements. "Recently, we have heard inquiries about reading 2-D codes from a mobile phone screen, through car windshields and various direct-part marking scenarios. Each of these presents a challenge for correct illumination and capture of the code," Paufler says. "A well thought out test plan will let you know if a solution will be scalable to the enterprise. End user involvement will help identify and eliminate adoption barriers when the time comes out for implementation."

It's also important to evaluate the applications and databases that will be used to process information from the bar codes. If these systems were originally set up to simply record a serial number or SKU from a linear bar code, back-end processes will have to be rethought to make sure the right information is being collected, displayed, and transmitted. "In many cases, end users will think about the efficiencies of the code without taking a look at the technology capturing that code, or the specific data points embedded within that code," Roeder says. "You really need to build a cross-functional team, including IT and the workers who will be using the 2-D codes day after day, to make sure that the entire system is built with everyone's needs in mind." •