White Paper

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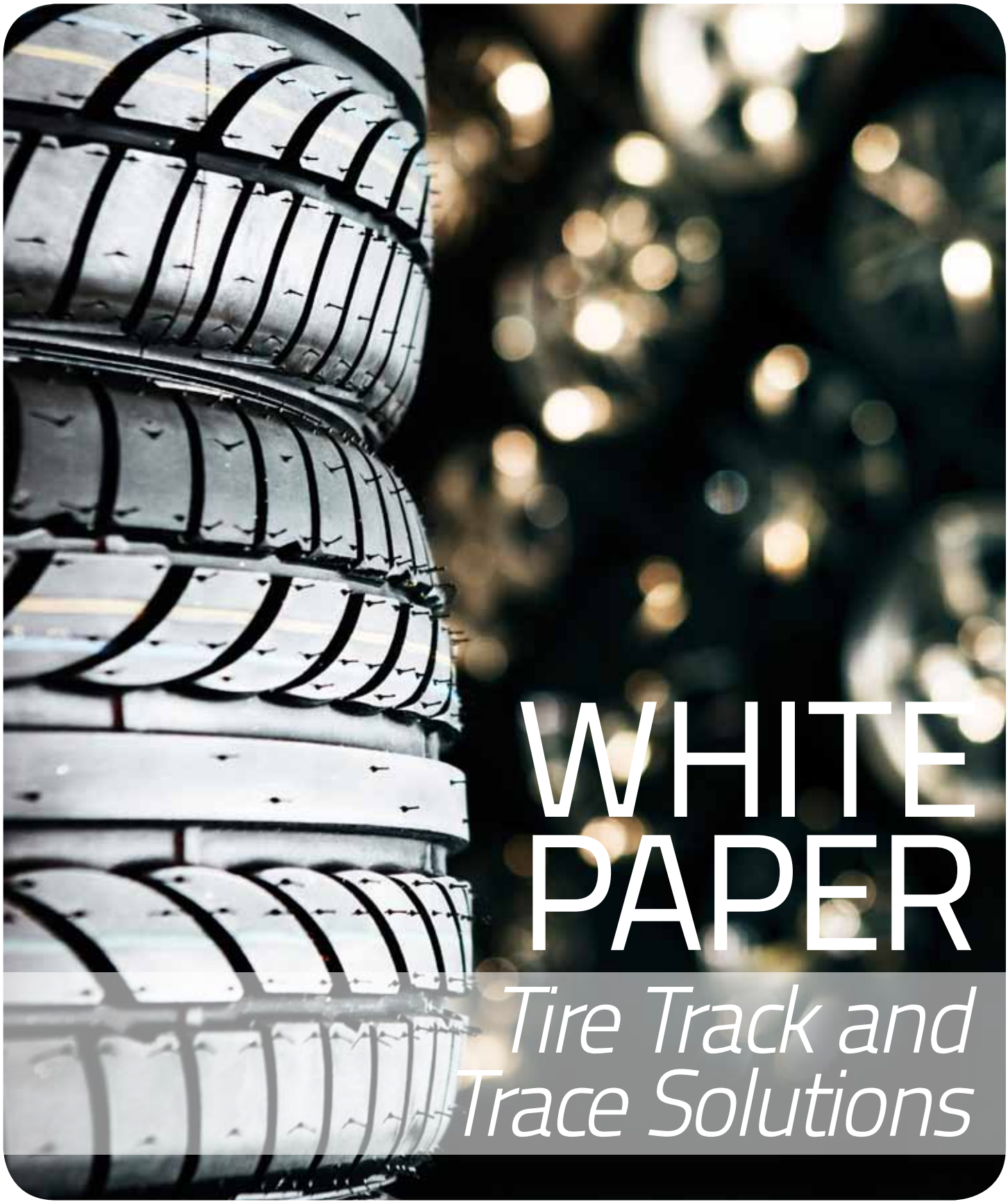

WHITE PAPER

Tire Track and Trace Solutions

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Modern tire manufacturing is an intricate blend of custom materials, running through multiple machine processes in a harsh mass-production setting. An industry-wide environment of increasing safety and regulatory concerns, has developed a need for reliable traceability of all tire components, as well as the requirement for stringent production and quality control. In meeting these needs, the now standard, marking of tires with bar codes places a high demand for reliable and robust tracking solutions in the unique industrial environments of tire production.

Tires need to be tracked in every phase of their handling. This task is made harder by the variability of modern tire styles and designs. In addition, capturing bar code data is especially challenging because the codes are small and located in the bead area of the tire, making it difficult for automated equipment to read. Bar code systems must be robust while providing reliable readings, seamless integrations, and easy maintenance.

In addition to mere traceability, tire tracking solutions must continually live up to the increasing scrutiny placed on the integrity of the tire manufacturing process. Modern bar code reading systems should minimize maintenance costs, measure dips in performance, and catch potentially costly mistakes before they spread.

A comprehensive look at current tire tracking solutions used throughout the manufacturing process can reveal a number of best-practices and best-in-class solutions that can provide significant cost-savings & efficiency improvements.

TIRE ASSEMBLY MANUFACTURING

The first major stage of Tire Manufacturing is the assembly process. At this point, a series of component materials are dispensed off of their specific spools and placed together on a building drum. Each of these components are themselves a complex assemblage of rubber, textile fabric, and specialized additives which have been designed and pre-manufactured for use in specific tires. These components include the inner liner, body plies & sidewalls. Once assembled on the drum, the tire bead is married to the tread wall, the tire is inflated, and finally the side-tread, steel belts and caps are applied. The result is a Green Tire that has been assembled from very specific component materials and is ready to be cured or vulcanized.

The final step before the Green Tire leaves the assembly process is the application and reading of a bar code that will allow for the tracking of the tire as it proceeds through its manufacturing. The bar codes are small (3/8 – 1/2 inch in height), low-aspect ratio, and placed in the hard-to-see bead area of the tire.

Multiple bar code reading applications are required during the Tire Assembly Manufacturing. The codes on the spools of component materials are read & verified as they are placed on the assembly machine. The assembled Green Tire must also have its bar code read, after it has been applied. Typical tracking solutions at this stage include laser scanners (raster or oscillating mirror) and 2-D imagers.

Best Practices for bar code capturing solutions in Tire Assembly include:

- No Moving Parts
  Use of scanners with oscillating mirrors creates an unnecessary additional point of wear and failure.
- Reliability / Accuracy
  Tire industry barcodes are inherently short in height and also suffer from poor printing which creates 'quiet zones'. These issues are particularly problematic for Laser Scanners (even with raster patterns), while 2D Imagers can compensate for bad quiet zones, have higher resolution, are unaffected by code height, and provide multiple reads of the bar code.
- Positive Feedback
  Bar code capturing systems that provide the operator a positive feedback sign (stack light or other visible sign), when the code has been correctly read.

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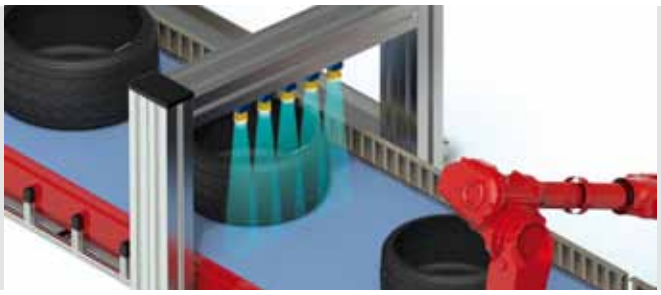

CURING / VULCANIZING

Once a Green Tire has been assembled and coded, it will be cured at high temperature and pressure in order to give it its final shape as well as to create a chemical reaction in the components to give the tire the resistance, strength and elasticity it requires to perform as a finished tire. The Green Tire is conveyed into a mold, which closes and heats the tire for approximately 15-20 min. When the mold opens, a patterned finished tire is removed and conveyed to the Final Finishing and Inspection stages.

The Green Tires must be tracked as they are conveyed into the curing mold. The nature of the tire curing press is such that it can suffer severe damage if a Green Tire is cured in the wrong size mold. At the very least, the materials used in the tire must be scrapped if used in an incorrect press. In addition to directing each tire to the correct press, the temperatures and pressures applied to the specific tire should be recorded, tracked, and stored for future analysis.

The need to effectively track Green Tires though the curing stations requires specialized bar code capturing solutions. A combination of the harsh environment surrounding the curing presses, in addition to the small sized codes placed on tires of varying shapes, requires robust and reliable solutions. The quality of bar codes themselves continues to degrade as they are scuffed by handling and curing. This intensifies the need for bar code capturing solutions that can reliably identify the tire's code.

Best Practices for bar code capturing solutions in Curing Station include:

- Robust
  Whether capturing codes on individual tires or on racks of them, minimizing the use of solutions with moving parts (such as scanners with oscillating mirrors) will keep bar code trackers in operation longer.
- Reliable / Accurate
  As Tires are handled through the curing process, the inherently short bar codes degrade and become increasingly harder for lasers to find and identify. 2D imager solutions can more accurately identify individual tires as they are conveyed to the press, or on the racks of multiple tires even in start-and-stop applications.
- Positive Feedback
  In situations where directing tires to the wrong press can be costly and time consuming, it is especially important to provide the operator a positive feedback (stack light or other visible sign), when the codes have been read and processed accurately.
- Easy of Integration
  Bar code capturing solutions should support the communication protocol used through the manufacturing process. Devices that come with 'backup & restore' modules or come pre-configured & pre-calibrated, allow for ease of installation and replacement by non-skilled operators.

FINAL FINISHING & INSPECTION

Many tires require additional operations before they receive their inspection. The final finishing can include multiple processes such as balancing, white-walling, the removal of excess rubber left from the curing mold and the grinding of sidewalls. These steps raise rubber dust particles into the air.

After all final finishing steps are concluded, tires undergo visual and machine inspections. These include tests where the tires are spun and verified for uniformity, quality, balance, as wells as x-ray verification of the steel cord structure.

Final finishing and inspection stations are such that bar code readers can not be placed near the tire during the process. This necessitates solutions that can be small and unobtrusive while accurate from a distance. In addition, the small bar codes tend to have become distorted, dirty, or degraded in quality from rough handling and the curing processes. These codes now need to be read on a high skew angle near the bead of the tire as it is spun in a finishing or inspection station.

2D imaging solutions outperform laser-based scanners during Final Finishing & Inspection:

- The far-distance required combined with the low-aspect ratio of the bar code makes the laser scanning solutions less accurate & reliable than 2D Imagers.
- 2D imager solutions can be turned on when needed, based on tire presence inputs, as opposed to laser scanners. This increases the functioning life-span of 2D imagers over Laser-based solutions.
- Instant Positive Feedback (light stack or similar) can be easily provided with 2D imagers. As the codes on the tires degrade through rough-handling, it is important for operators to know if the codes have become unidentifiable, as these tires need to be taken off the production line for re-inspection, or removal.

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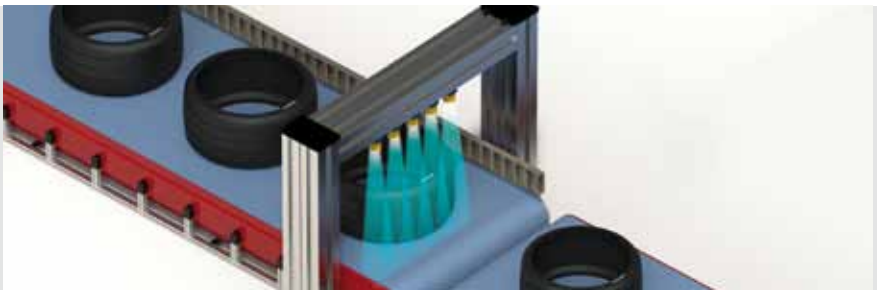

SORTING & SHIPPING

Once tires have passed their inspection, they travel through a network of conveyor systems to arrive at their final packaging destination. Bar code tracking determines the path of the tire through the conveyor system. It is essential that the codes on the tires are read accurately as the progress down the conveyor. Loss of data in the production plant due to a reader failure, can incur huge costs to ensure traceability and in productions stops.

Current bar code capturing solutions over sorting conveyors include:

Laser scan tunnels

- Many (Up to a dozen+ lasers scanners in a pattern)
- Laser scanners are inherently inferior at scanning the codes on tires in this environment.
- The small, poor-quality (scuffed & damaged), high skew angle bar code is easy for laser scanners to miss.
- The varying height of the bar code (due to tires of varying design and size) decreases reliable scanning
- Laser scanning solutions attempt to overcome the inherent low performance in the laser scanner by adding lots of scanners in different patterns. This creates more points of failure, and greater maintenance costs.
- Skilled technicians are required to calibrate and recreate the patterns of a laser tunnel, when a scanner fails.

Long Range Linear Cameras

- Creates a single, full image of the tire, one line at a time.
- Since only one image of the tire is made, only one chance to read bar code exists. If the code happens to have a glare, reflection, or dark-spot at the point the camera finds the code, it will not be read.
- When a linear camera fails, highly specialized technicians are required repair and re-calibrate it. Long lapses in coverage or costly production stops are caused by complicated maintenance & repair.

Multi-head 2D imager arrays

- 2D imagers are not affected by varying height to bar code.
- Multiple images of the same bar code are taken to compensate for glare and poor-quality codes.
- No moving parts = lower failure rate.
- By using multiple imagers in an array, there is redundant area coverage. If one imager fails, there is only a small reduction in read rate.
- **Best in Class:** Utilize arrays with 5-6 imagers (more redundant coverage)
- **Best in Class:** Pre-configured solutions require no calibration, can be installed and replaced by non-skilled operators.
- **Best in Class:** Solutions with positive visual indicators for operators (light on tire or stack light), can quickly lead operators to issues before they can spread and become costly.

ADDITIONAL BENEFITS TO RELIABLE BAR CODE CAPTURE:

Efficient processing of tires as they are conveyed through the Sorting & Shipping process is essential in the high volume modern tire production. Tires with and without barcodes are mixed together, requiring these labeled & unlabeled tires to be sorted out and consequently re-processed through the conveyors, or manually inspected/rejected. In these cases there are new benefits to be gained from implementation of the more reliable bar code capturing solutions. Traditional bar code reading solutions return a state of 'successful bar code reading' or 'unsuccessful'. A Solution built from an array of 2-d imagers can accomplish a double functionality from a single location: if a code is not successfully read, the 2-D imager arrays can distinguish if a code was present (**but not read**), or if the code was not present on the tire at all. By identifying this additional state (**No Code Present**), the 2-D imager arrays, allow for automatic sorting of tires missing codes vs. unread codes. This logistical improvement can create large efficiency impacts to the tire handling and transportation systems.

SYSTEM-WIDE BENEFITS TO COMPATIBLE BAR CODE CAPTURING SOLUTIONS

Solutions utilizing 2D imagers have shown to be at the top of the tire tracking options available for each manufacturing stage. Though each process has unique code reading requirements, there are cost and efficiency benefits to be gained from analyzing all the solutions used.

Lower Inventory Costs:
By utilizing the same imager throughout the manufacturing process, a much smaller number of replacements need to be held in inventory. The same 2D imagers used in arrays over conveyors can also be used individually at other stations.

Lower Maintenance Costs:
In addition, by choosing 2D imagers with no moving parts, and 'Backup & Restore' functionality, replacement can be performed by non-skilled operators.

System-Wide Monitoring:
A large deployment of 2D imagers collecting data through the tire manufacturing process, in conjunction with monitoring software, can identify huge cost efficiencies. Throughput can be monitored from any location. Maintenance can be automatically directed where needed. Work-In-Progress inventories can be analyzed real-time. Images & information is stored system-wide for troubleshooting and efficiency analysis.

Future-Flexible Solutions:
As bar codes may change over time, 2D imagers are capable of handling 2D barcodes if industry standards change.

Coding and tracking of tires throughout manufacturing has become a requirement in the industry. The traditional reading systems based on laser technology have permitted good reading performance only in some situations, utilizing sophisticated configurations and with low flexibility. 2D imaging solutions offer excellent reading performance even under the unique & harsh conditions of tire manufacturing.

ABOUT DATALOGIC

Datalogic Group is a global leader in Automatic Data Capture and Industrial Automation markets. As a world-class producer of bar code readers, mobile computers, sensors, vision systems and laser marking systems, Datalogic offers innovative solutions for a full range of applications in the retail, transportation & logistics, manufacturing and healthcare industries. With products used in over a third of world's supermarkets and points of sale, airports, shipping and postal services, Datalogic is in a unique position to deliver solutions that can make life easier and more efficient for people. Datalogic S.p.A., listed on the STAR segment of the Italian Stock Exchange since 2001 as DAL.MI, is headquartered in Lippo di Calderara di Reno (Bologna). Datalogic Group as of today employs about 2,400 members of staff worldwide distributed in 30 countries. In 2012 Datalogic Group achieved revenues for 462,3 million Euro and invested over 32 million Euro in Research and Development with a portfolio of over 1,000 patents across the world. For more news and information on Datalogic, please visit www.datalogic.com.