EDGE COMPUTING

Transform Line Operations with Performance Monitoring and Asset Management

COGNEX

EDGE COMPUTING

Bring smart data collection and performance monitoring to your line

The expansion of Industry 4.0 through the Industrial Internet of Things (IIoT) focuses on improving industrial and manufacturing operations by collecting and analyzing data from a wide range of sensors on production lines. This information enables factories to generate and implement valuable efficiency enhancements.

Typically, data generated by IIoT sensors transmits via a gateway to centralized cloud applications such as a manufacturing execution system (MES), enterprise resources planning (ERP), and a wide range of other line-of-business and operational software. Distributing all that data, modeling it, and then running analytics requires a lot of computing power in a centralized system.

But as devices on the factory floor have become smarter and more robust, they both generate more data and are more capable of analyzing that data themselves. Moving processing closer to the devices gathering data, or "the edge," eliminates delays caused by sending data up to the cloud and back (latency), reduces network congestion, and increases reliability.

Used properly, these new capabilities can move many operational decisions back to the production line, where they were before the rise of centralized applications and cloud computing. It will provide controls engineers with real-time visibility into the operations of the production line, allowing for improvements in overall equipment efficiency (OEE).

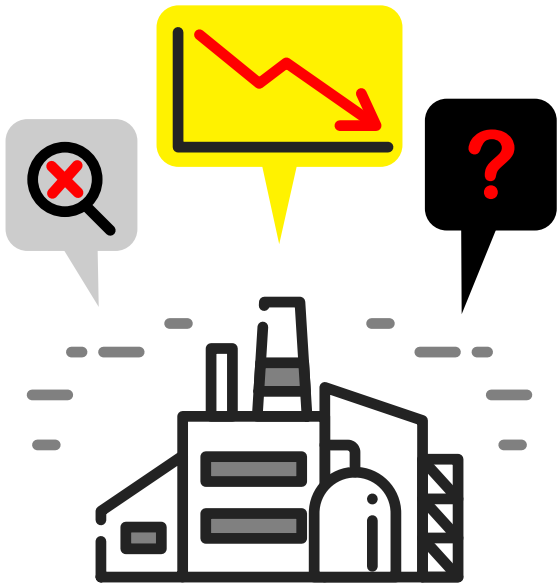
This will not replace those centralized systems, but will increase their capabilities, while increasing decision speed and decreasing network load. Organized, cleaned, and analyzed data about line performance and detected incidents goes up to the cloud to be combined with data from other lines and departments. The result is a comprehensive operational understanding, and a clear picture at an organizational level.

CHALLENGES AND OPPORTUNITIES ON MODERN PRODUCTION LINES

Keeping today's complex production and distribution systems running efficiently and reliably is a difficult task, and machine vision systems have been helping automate these key manufacturing processes for years. Success of these facilities is often measured on throughput, and any disruption to these process flows carry heavy costs and penalties. As a result, quick action is necessary to resolve issues and minimize downtime, as minutes of lost production or shipments can cost thousands or even millions of dollars.

However, production managers often lack the right system performance data to adequately diagnose issues as they occur and are therefore left guessing when issues arise. The performance monitoring information that they do have is often restricted to overall averages instead of showing specific or trending issues. Lack of visibility into line operation leads to:

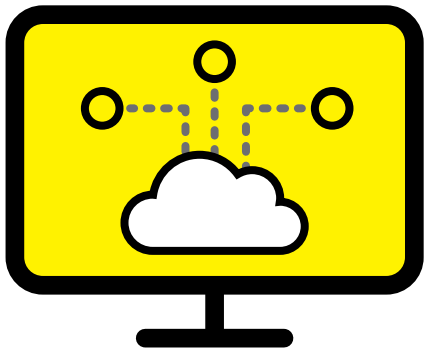
- Unplanned downtime
- Deferred or unnecessary maintenance
- Inability to identify and pinpoint where waste occurs
- Failure to identify causes of rate drops and errors
- Inability to measure, benchmark, and improve performance over time
- Failure to increase throughput
- Ineffective communication to plant management



In addition, device management can be cumbersome as operations scale up. Without a system to track even minor changes to settings, negative impacts to overall performance become harder to diagnose.

Production-specific IIoT is moving to the production floor, along with increased computational capacity. This puts more information and analytics in the hands of line engineers and extends their ability to understand and control the lines they manage.

THREE WAYS EDGE COMPUTING PLATFORMS CAN TRANSFORM LINE OPERATIONS



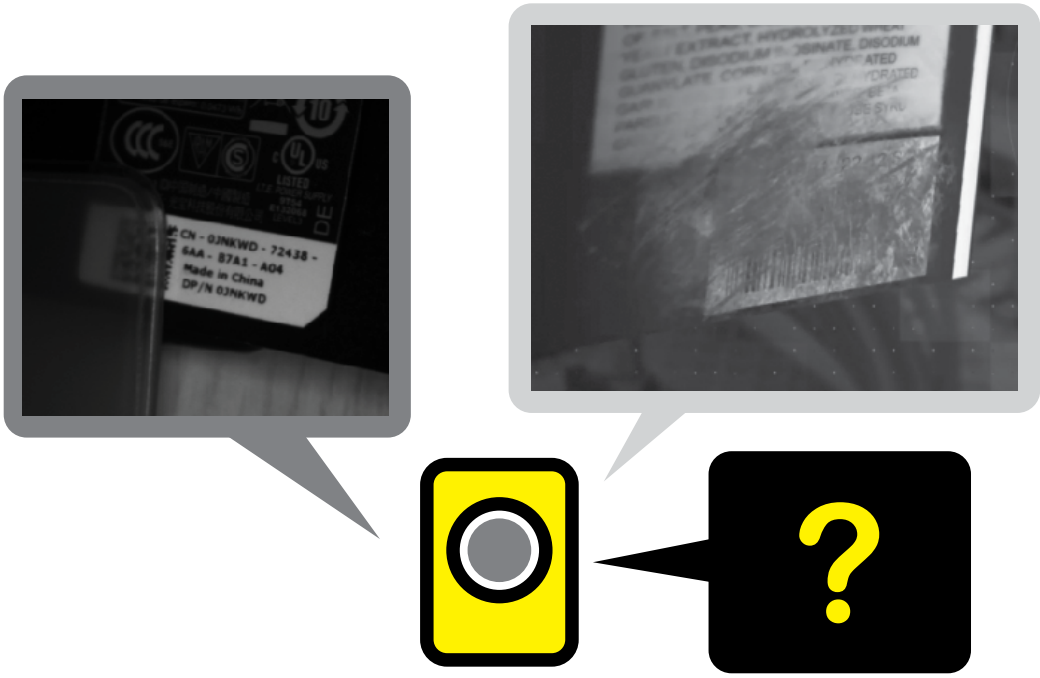
1. Real-time performance monitoring

The smart cameras along a production line are designed to tell the user something about the images they acquire. From reading barcodes to inspecting product quality to guiding robots to measuring part tolerances—smart sensors are transforming modern production and distribution centers around the world.

Using the full range of sensor data

The image a smart camera acquires contains a lot of information, and in the case of industrial barcode readers, the system can do more than just read the code contents. It can suggest where the barcode was applied, the print quality, what damage it might have suffered en route from the printer, as well as internal camera performance information. The more sophisticated the camera, the wider and more detailed the information.

All of this data can be used to answer one important question: if the barcode did not get read successfully (commonly referred to as a “no read”), what was the cause?



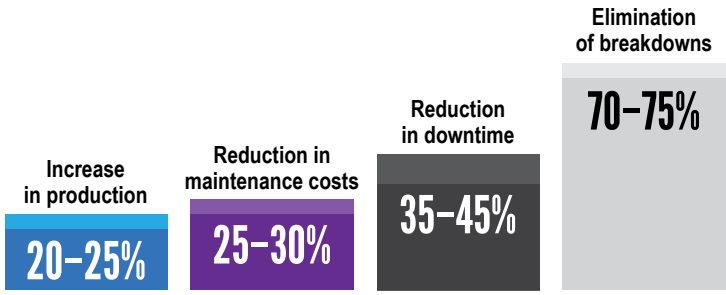
Understanding the underlying causes of declining read rates

If a system is running at 40 parts per second and the read rate begins to decline, the system can quickly become overwhelmed with rejected packages or goods. At that point the dilemma becomes: should the line be stopped and a technician called out? It is a risky bet, no question—every minute counts, and that decline in the read rate could be the result of some temporary anomaly that has nothing to do with either the part or the barcode, and there may be nothing for that technician to find.

This is where performance monitoring demonstrates its importance. By continuously reporting all data from every camera, edge computing platforms can provide continuous and detailed monitoring of performance. Combined with active storage and analytics, this data can form a complete historic record of conditions on the line.

Over time, it becomes possible to detect the first signs of upcoming failure long before there is any effect on performance.

Independent surveys of energy companies indicated the following industrial average savings resulting from a functional predictive maintenance program:



Source: US Department of Energy O&M Best Practices Guide, August 2010

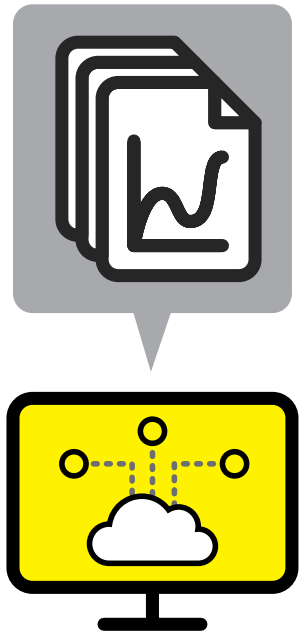
Every time there is a problem, the controls engineer can look back to see if any anomalies preceded it. Over time, edge computing and predictive maintenance make it possible to detect the first signs of an upcoming failure long before there is any effect on performance. The company would then start to see a reduction in maintenance costs and downtime.

For example, if runtime wear causes a printer malfunction, such as misplaced/torn labels or a clogged nozzle, after some period of time, it becomes possible to identify the root cause and ensure that printer service is performed exactly when needed.

Getting reports with actionable information

Often production engineers must pull spreadsheets, clean the data, and generate pivot tables and other data displays just to organize and understand information about their own line. This can be time consuming and often excludes valuable information.

Edge computing platforms enable the creation of reports that can be distributed at regular intervals to provide information about metrics of interest, without requiring additional work. Crucial information from those reports can then be extracted and sent on to management for rapid decision making.



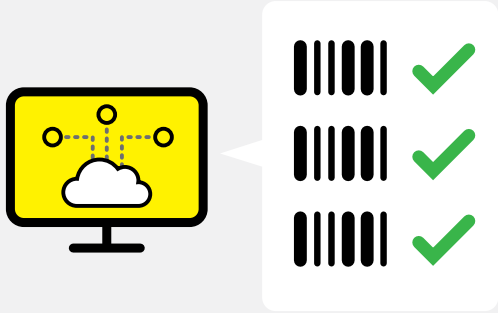
Such reporting allows an engineer to keep a pulse on a significant number of lines. If there is variation between one line and another, the variation can be reviewed to determine the underlying causes. Alerts can be set to notify if performance measures, such as read rate or throughput, drops below certain thresholds.

Using code records as compliance insurance

Large producers and original equipment manufacturers (OEMs) who use parts from other manufacturers typically set code quality standards for their suppliers and can contractually reject anything with labels below a certain quality. But, frequently, that OEM might have barcode reading issues of their own.

Without an edge computing solution, if a customer rejects parts for failing to reach required code quality, it is hard to verify the claim. And sometimes reinspection does show problems with the labels or codes, but not where those problems originated.

If an edge computing solution is in place, however, and there is a clear record of each and every barcode and label, it becomes easy to demonstrate that if there is a problem, it must have occurred after the part left the manufacturer's facility. There will be no need to go through all the products that are due to be shipped to search for problems.

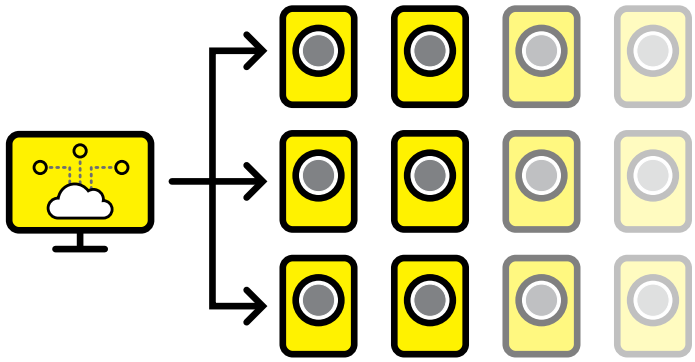


2. Manage a broad network of devices all at once

Setting up a new production line involves complex coordination of many different mechanical and electrical systems. Installing the many sensor systems which enable them is no exception. Each device may require its own software setup interface along with a physical connection to the device.

There may also be a tunnel which requires dozens of smart cameras or a production line with 100s of cameras, or an application that uses multiple devices to get a synchronized 360-degree view of a product. Plus, managing the setup in this classical way is time consuming and error prone.

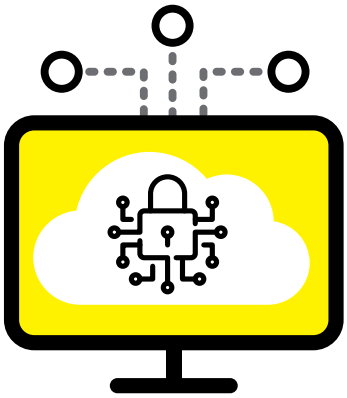
However, edge computing systems can streamline the management of multiple cameras simultaneously: setting IP addresses, loading firmware, and installing configuration files. This ensures that each device has exactly the same features and software, and that over the course of their deployment there is no variation in software from one to the other. It also provides a log of all configuration changes in case a software change negatively affects performance.



3. Data transportability, interoperability, and security

Edge computing platforms can generate a significant amount of data for real-time performance monitoring and analysis of line performance. But that is only the start of this data's usefulness. Filtered, integrated, and analyzed, this data can serve as input to a wide range of other systems, including ERP, MES, and specific line of business applications hosted in the cloud.

Decisions at every level benefit from the data that edge computing software generates. Given the way systems and software have typically been acquired and updated, a plant and a business generally have numerous devices and software, from different manufacturers, with different message standards and protocols. Once edge computing is available to a company, a wide range of functions will find a use for the data.



Edge computing has the capability to generate data in many formats, usable without processing by other systems, allowing for better decision making at every operational level.

Performing computation at the edge also has security advantages. By distributing processing, storage, and applications to various locations, edge computing makes it much less likely that any disruption will take down the entire system. Additionally, by processing data locally rather than sending every bit to the cloud, edge computation minimizes the amount of data exposed in transmission.

Identifying unauthorized changes to readers

A key advantage of edge computing is the ability to easily drill down to understand if the issue is at the line or reader level to see if there is some kind of outlier in the code quality, monitor contrast, code position, or other metric. This kind of root-cause identification can expose some interesting and too common misbehavior.

In a busy plant running multiple shifts with multiple lines and reporting requirements for excessive no-reads or delays, there can be a strong temptation to tweak an offending camera to lower that no-read rate below the threshold, on that line, for that shift. The next day the first shift engineer will see that something has changed but be unable to figure out exactly what changes were made and when. Once there is clearly a problem, the offending individual may be reluctant to volunteer information. A quick “optimization” for one specific situation has led to a more significant slowdown overall.

With edge computing, the engineer can go in, see exactly what the changes were, when they were made, and what the effects of that change are. They can revert to the previous state. After that situation is fixed, a more extensive analysis can then be run to see what, overall, might have been causing that high no-read rate. Addressing the root cause will minimize the temptation for ad hoc camera adjustments in the future.

	Previous Settings	Current Settings
EXPOSURE	80 us	80 us
GAIN	5	5
LIGHT INTENSITY	15	15
CODE 128	✓	✓
CODE 39	✓	✓
UPC/EAN		
CODE 93	✓	✓
2D DATAMATRIX		✓
POLARITY	DARK ON LIGHT	DARK ON LIGHT
MIN LENGTH	12	12

WHAT TO LOOK FOR WHEN ACQUIRING AN EDGE COMPUTING SOLUTION

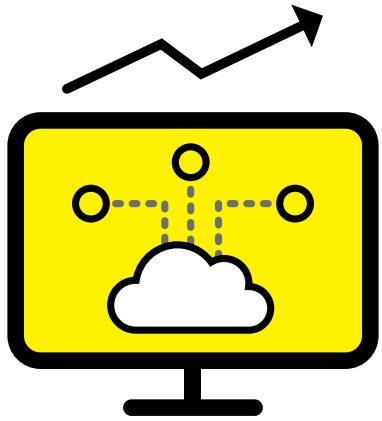
A good edge computing solution should be able to both show straightforward, immediate benefits, and enable organizational growth in the long term. It should be able to output useful data and reports to all existing systems. Perhaps most importantly, it should be optimized for the specific requirements of production.

Since any edge computing solution will be a partner for a long time, the decision is significant. The wrong one can significantly constrain future growth. Fortunately, there are some clear criteria for judging and comparing edge computing solutions for the production line and the plant.

Immediate functional improvement

The solution should show immediate benefits to the engineer. It should not require any changes to either equipment or procedure. Edge computing should take the data smart cameras already generate, integrate it, filter it, and turn it into a form useful for making decisions about the production line.

This should be easy and straightforward, fitting into existing workflows without the need to acquire additional skills, detailed knowledge of vision systems, or the ability to interpret large amounts of new data. It should not make the controls engineer's job harder or more complicated, and should not require attention already budgeted for existing tasks.



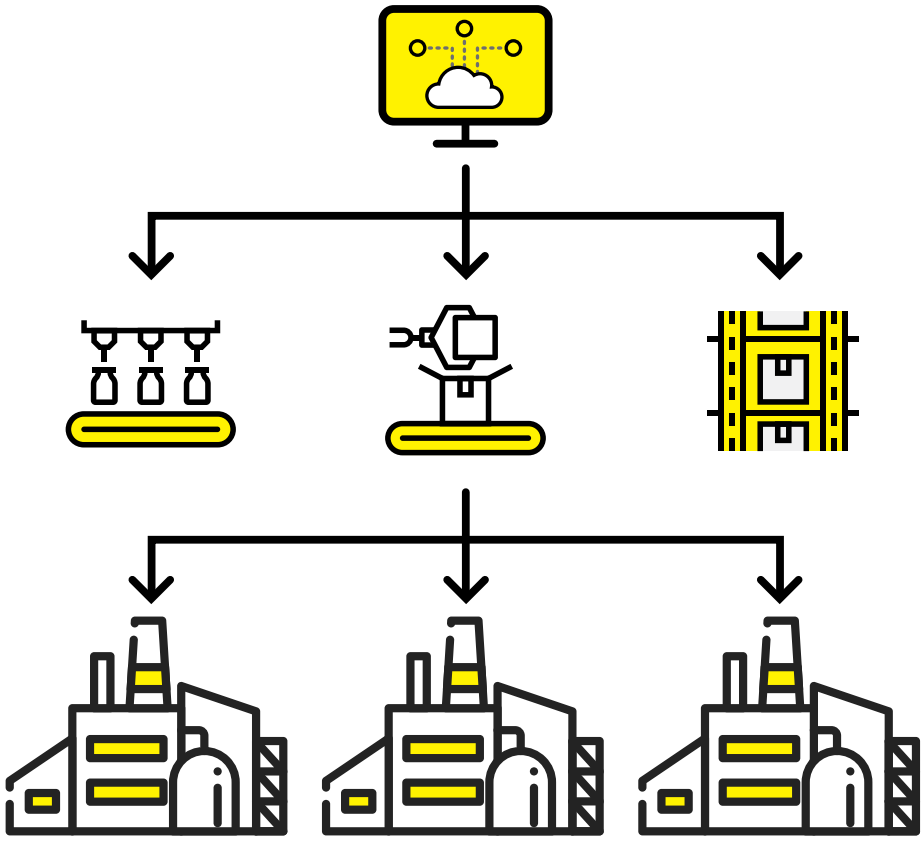
The edge computing device should plug into an Ethernet switch, get connected to a PLC, and be useful from activation. It should be something for the engineer to use and experiment with, without negatively affecting existing metrics.

Long-term growth

Scalability may seem like a buzzword, but it has real significance in business planning. Many seemingly workable small-scale solutions become cumbersome and labor-intensive when they are used more widely.

The ability to start small is just that—the start. As the production line using an edge computing platform starts to report on its improved productivity, there will inevitably be pressure to expand and implement edge computing broadly.

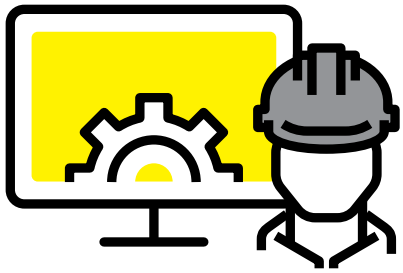
With each extension of scale, there is a wider range of data, more interconnections with other systems, and a greater risk of data overload. The chosen solution will need to handle that kind of growth without requiring custom modifications, costly additional systems, or third-party consultants.



Built for your specific application

Many edge computing software solutions are generic. They are billed as applying to almost any domain, so it can be a top-down solution that does not consider the day-to-day details of work on the production line.

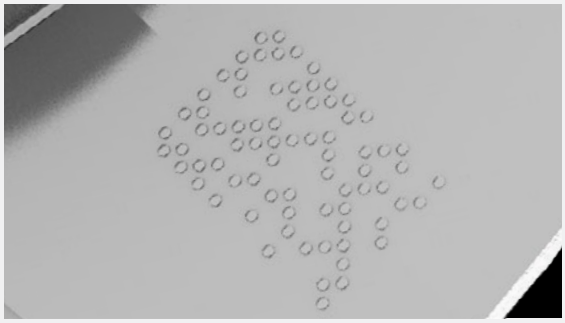
The solution should not require the user to know a lot about vision systems, statistics, or interface design. A controls engineer doesn't need to see all of the data—they need to see the right data, or data specific to their application. Only an edge computing provider with intimate knowledge of production line operations can provide user interfaces, displays, and reporting that support the engineer without imposing extra work or frustration.



Making the invisible visible

In direct part marking (DPM) a code is marked directly on the part, rather than using a label. That is useful in certain settings, but does mean that the code is read directly off the substrate.

If the barcode reader is optimized for the current run of parts, and a subsequent lot is more matte or shiny, read rates will drop. The engineer may tweak the reader to get the rate up again, only to have another unexpected drop when the surface changes again.



Without edge computing, this might remain a mysterious barcode reader malfunction, perhaps one that has resulted in a service call. With it, the engineer can go back through the history, see the adjustments to the barcode reader, and understand how they are correlated with parts shipments.

Output flexibility

The data generated by an edge computing system can be used by many different software and business systems in a modern plant. Uses for this rich data will grow and evolve over time. An inflexible or closed architecture that cannot export data consistent with a wide range of protocols will quickly end up imposing delays and costs, adding demands on already overburdened IT departments.

The edge computing system should work and play well with all other existing systems in the plant and company.

Getting the numbers up

With extremely high-volume operations, even a small error rate can result in a large number of rejected pieces. But because of the large number of different reasons for those rejections, there may still be no cost-effective way to deal with them.

Even at a 99.6 percent accuracy rate, an operation that processes 750,000 pieces per day will end up with 3,000 rejected pieces each day, over 15,000 a week. But it is unlikely that there will ever be the budget to hire half a dozen people to sort through 3,000 images of incorrect barcodes per day in order to flag the damaged labels, missing labels, incorrectly sized labels, and misrouted boxes. And even then, it is difficult to take those determinations and use them to make decisions about where to do maintenance or make improvements.

An edge computing system that displays errors for classification and serves up reports when needed will quickly reveal where improvements or modifications can decrease the error rate and reduce the number of rejects while keeping volume high.

EDGE COMPUTING SOLUTION

Improving speed and productivity requires greater visibility into what is happening on the line in real time. The Cognex Edge Intelligence (EI) platform provides that visibility to the controls engineer.

EI transforms big data into smart data to improve overall efficiency and throughput. It is fully integrated with Cognex devices and logistics tunnels to streamline device management, and uses the data generated to provide an industry-specific visual dashboard of system performance so operators can identify and resolve issues quickly.

To learn more, visit Cognex.com/edge-intelligence or Cognex.com/blogs.

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Companies around the world rely on Cognex vision and barcode reading solutions to optimize quality, drive down costs and control traceability.

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