Over the next decade, manufacturers will transform their current production facilities into “smart factories.” These new smart factories will be faster, safer, and more efficient than ever while churning out higher-quality products and minimizing production costs. In fact, the differences between the older facilities and the new/transformed ones are likely to be so great that many analysts are referring to this time period as another Industrial Revolution.

Three key technology trends — the Industrial Internet of Things, big data analytics, and edge computing — are making this transformation possible. Industrial Internet of Things sensors collect a vast array of data from manufacturing equipment or items in production and transmit it to devices that can store and analyze it. Big data analytics software sifts through the IIoT data, providing managers with insights into ways to streamline production, improve quality, and lower costs. Edge computing allows
much of that analysis to be done right on the factory floor, which reduces the burden on networks and other IT infrastructure while keeping expenses low.

As a result of these technologies, managers have much greater visibility into their production processes, which in turn can help them gain an advantage over their competition. Forward-thinking manufacturers are already beginning to invest in these new technologies. Analysts at McKinsey & Company estimate that by 2025, the economic impact of IoT in factories will reach up to $3.7 trillion annually.

One of the first ways that manufacturers are using smart factory technology is for predictive maintenance. They are attaching sensors to key pieces of production equipment in order to track information about pressure, temperature, vibration, flow, and other key indicators. By applying analytics to this data, manufacturers can understand whether the equipment is functioning within specifications and how key components are wearing.

An example of this approach can be seen in the IIoT gateways created by Dell and Intel. By combining Dell’s expertise in rugged equipment design with Intel’s leadership in high-performance computing, the two companies have created gateways that not only gather sensor inputs but also analyze the data on the factory floor. These gateways allow manufacturers to identify when corrective action is needed to keep equipment performing at its peak.

The results are impressive. For example, according to a study by Aberdeen Group, “best-in-class” companies using a predictive maintenance IIoT solution can improve return on assets by up to 24% while reducing unscheduled downtime by 3.5%, increasing overall equipment effectiveness by 89%, and reducing maintenance costs by 13%.

The Four Stages of Maintenance Maturity
Before they achieve the full benefits of predictive maintenance, manufacturers typically pass through three other stages of maintenance maturity.

The first, or lowest, stage of maturity is reactive maintenance. Factories operating in this mode wait until a piece of equipment fails before they fix it. Unfortunately, this approach often results in downtime for the piece of equipment — or for the entire production line — while technicians complete repairs. It can also make scheduling difficult because it pulls staffers away from their regular work in order to respond to emergencies.

To prevent these problems, some manufacturers have moved on to preventive maintenance. Much like car owners change their oil and replace belts after a certain number of miles, this approach involves swapping out equipment components or performing other maintenance work after a set amount of time or a certain number of cycles. This approach makes scheduling easier, but it still results in some equipment failures. In addition, it may mean that in some cases technicians are performing maintenance before they really need to.

The next stage, condition-monitoring maintenance, involves fixing equipment after the first signs of trouble. In this scenario, staffers monitor the performance of the equipment and conduct inspections on a regular basis. When they see that output has decreased or detect signs of wear, they schedule repair. This approach is much better, but still not foolproof. Condition monitoring requires considerable time and expertise, and it can still lead to occasional unplanned downtime when workers miss signs of impending failure.
Compare these stages with predictive maintenance. In this level of maturity, IIoT sensors gather data directly from the equipment. Software analyzes the data to detect anomalies and enable staffers to take corrective actions long before they would ordinarily detect a problem. This approach keeps downtime to the bare minimum while production output remains as high as possible.

The Predictive Maintenance Difference
To understand how predictive maintenance works in an actual factory setting, consider a vibration sensor attached to the motor on a piece of factory equipment. As with any motor, the equipment experiences some vibration while it’s in use, even if it’s operating up to specifications. However, when the motor begins to fail, one of the first things that happens is that the vibration begins to increase. In the early stages, this vibration isn’t enough for human workers to notice — the motor isn’t noticeably shaking, doesn’t sound louder than usual, and isn’t warm to the touch. But the electronic sensor can detect the change, and the predictive maintenance software can recognize the severity of the threat and provide personnel with the appropriate alerts and guidance on correcting the problem before the faulty motor affects production.

As this example shows, predictive maintenance offers four key benefits:

• **Reduced unplanned downtime.** Because staffers are aware of equipment problems well before failure, they are able to schedule repairs at a time when they don’t affect the production line.

• **Improved operation equipment effectiveness.** IIoT technology doesn’t only detect impending failures; it also pinpoints equipment that isn’t operating as efficiently as it could be, giving staff the opportunity to optimize performance.

• **Lower maintenance costs.** Fixing problems earlier often prevents small repair jobs from becoming bigger, more expensive repair jobs.

• **Increased return on assets.** Because equipment stays within specifications and runs more efficiently, manufacturers are getting better return on their equipment investments.

The Value of Edge Computing
Edge computing is a technique for making IIoT-based predictive maintenance more efficient and effective. In edge computing, devices analyze sensor data on the factory floor. The results of this analysis are then sent to the cloud or data center as needed to generate business insights.

This approach offers significant benefits. First of all, it allows organizations to make more efficient use of their

Product Spotlight: Dell Edge Gateway 5000

The Dell Edge Gateway 5000 is durable enough to gather data where it’s generated and intelligent enough to run analytics software locally. It features a powerful Intel® Atom™ processor, 2GB of RAM, a 32GB SSD hard drive, and an industrial-grade chassis that can be mounted on the wall or DIN rails. It also includes Trusted Platform Module 1.2 security, ensuring that IIoT data doesn’t fall into the wrong hands. And it easily integrates with existing operational technology and IT systems to simplify deployment and keep costs low.
network resources. A typical IIoT sensor might collect data about equipment temperature or pressure every couple of seconds or even several times a second, and the IIoT network might include dozens or hundreds of these sensors. If the solution had to transmit all of those individual pieces of data to a centralized data center or cloud computing facility, it could literally consume all of the available bandwidth on the company network. But with edge computing, factory devices do most of the analytics, significantly reducing the data that needs to travel across the network.

In a similar way, edge computing saves companies money on their cloud computing costs. Most IIoT data is only valuable for a brief period of time, and then it can be deleted. If companies must pay to store this data on a public cloud service, their costs can quickly skyrocket. With edge computing, the amount of data stored is kept to a minimum, as are the related expenses.

Edge computing can also help to ensure availability. In some IIoT deployments, Internet connectivity isn’t always available because of factors such as the equipment’s remote location or the unreliability of a mobile connection. With edge computing, the solution doesn’t need an Internet connection in order to do its analytics work.

Dell-Intel Edge Computing Case Study
Over the last several years, Dell and Intel have closely collaborated on purpose-built IIoT solutions that combine Dell’s expertise in rugged devices with Intel's leadership in high-performance computing. One example is the Dell Edge Gateway 5000, which enables edge computing by aggregating, integrating, qualifying, and relaying data from the edge back to the data center or cloud. It offers benefits such as standards-based architecture, ruggedized hardware, built-in security features from Intel and Dell, and easy integration through common interfaces with existing IT and operational technology infrastructure. Unlike some competing solutions, it does not require rip-and-replace of existing assets, so manufacturers can continue to use their existing production equipment and IT infrastructure.

In addition to working with Intel, Dell collaborates with a range of industry partners to enable an end-to-end predictive maintenance solution that smoothly integrates into both factory settings and cloud and data center environments. Those partners include Kepware, maker of the KEPServerEX, a communications platform for industrial automation data; Software AG, which offers Apama, a streaming analytics platform; and SAP, with its HANA in-memory database.

The resulting solutions can yield all the benefits discussed here, including reduced unplanned downtime, improved equipment effectiveness, lower maintenance costs, and higher return on assets.

Predictive Maintenance Is Just the Beginning
Predictive maintenance IIoT solutions such as the one that Dell and Intel have created could be used for other purposes, including real-time quality control or compliance initiatives. As manufacturers get started with smart factory technology, they often begin to see new uses for the solution beyond those they initially imagined. Deploying a predictive maintenance solution helps organizations get
crucial elements of IIoT infrastructure in place that enable later expansion into broader usage models.

In addition, IIoT solutions can also be used in settings beyond the factory floor. Some of the earliest adopters of this technology have been the transportation and energy industries. Today, IIoT is helping prevent accidents on drilling rigs, improving the efficiency of trains and trucks, and reducing operational costs for a wide variety of organizations.

In short, organizations can get ahead of the competition by investing in IIoT infrastructure today. The best path forward is to take advantage of holistic solutions — such as those offered by Dell and Intel — that smoothly integrate with existing assets and infrastructure. By getting an early start with predictive maintenance, manufacturers can set themselves up to realize the full benefits of the smart factory.

To learn more, visit dell.com/en-us/work/learn/internet-of-things-solutions.

SMART FACTORIES BUILT ON COLLABORATION

Intel’s partnerships with IoT leaders such as Dell are bringing transformational change to industries worldwide. With best-of-breed solutions for smart factories, these partners are helping manufacturers unlock operational efficiency, optimize production, and increase worker safety.