



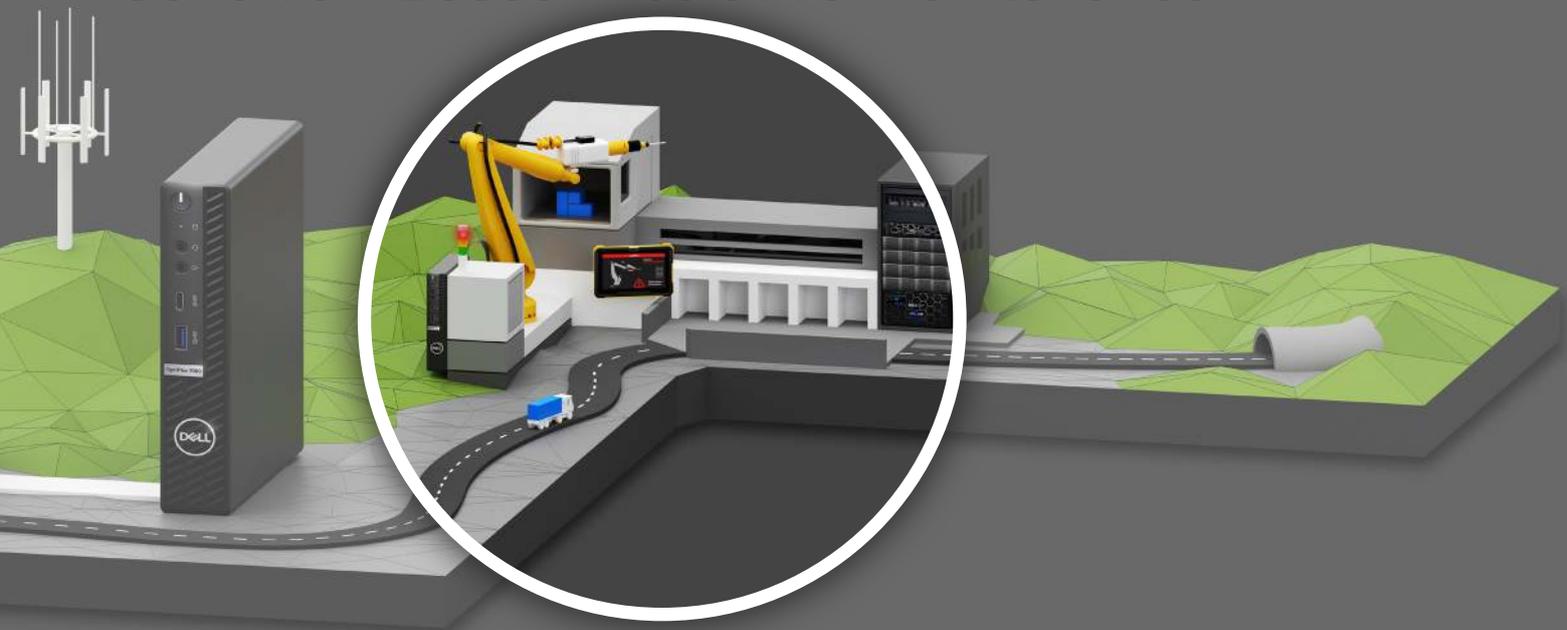
SMARTFACTORY

USE CASE

intel[®]

Predictive Maintenance

Condition-Based Predictive Maintenance

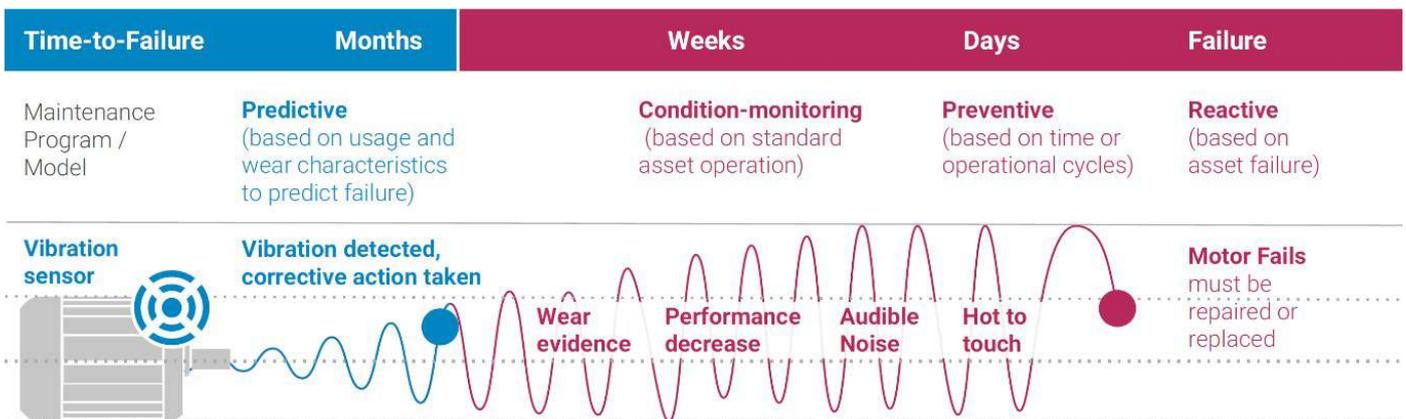


When operating an industrial system, machine availability and the reject rate are elementary key figures. A system that ideally remains in operation without downtimes and outages and at the same time manufactures products of the highest quality is the ultimate goal. With this in mind, plant operators are looking for ways to reduce or even predict downtimes.

“Predictive maintenance” presupposes the permanent monitoring of a machine or an entire plant. This classic case model of Industry 4.0 includes the early detection of whether a machine behaves differently than normal or deviates from specified tolerances. For this purpose, sensors are used which measure, for example, electrical power, pressures, temperatures, revolutions or vibrations. The aim is to indicate possible restrictions in use or even failures of individual components or the entire machine before they actually happen and lead to a production standstill. The main objectives to be achieved by “Predictive Maintenance” are:

- Increased plant availability by reducing unplanned downtimes
- Reduced costs for monitoring by technicians, especially for remote installations
- Reduction of downtimes and maintenance costs by guaranteeing maintenance at the “right” time
- Enhancement of OEE (Overall Equipment Effectiveness)

Unlike other types of maintenance, the aim is to detect problems that arise on a machine as early as possible and to take countermeasures. The following graphic shows the example of an engine with vibration sensors and the time advantage that condition-based predictive maintenance offers.



Recommended steps for successfully implementing a Predictive Maintenance solution:

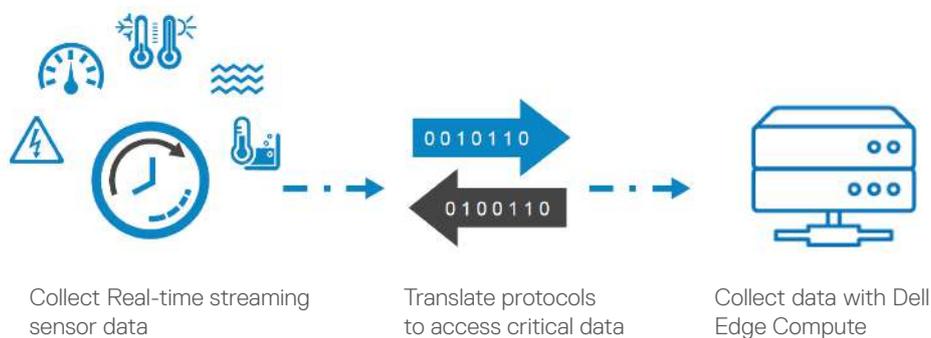
1. Identification of systems and components that are likely to suffer an outage and incur high costs

Does your company have one or more machines that incur high maintenance costs and / or are known for unplanned downtime? It is important to first identify the machine(s) with a high savings potential. Predictive maintenance can be the solution for such cases, especially if the specialist department is aware of the problems but is unable to find a solution to solve them.

2. Is the machine already equipped with sensors or must these be retrofitted?

If the machine is not yet equipped with sensors such as environmental sensors, vibration, electrical power, ..., our business partners will be happy to help you in selecting and implementing the appropriate "retrofit." In many cases, a single sensor is sufficient to achieve initial results.

Of course, special care is taken not to interfere with the machine itself so as not to lose warranty claims against the manufacturer.



3. Collection of the generated sensor data

The sensor data are continuously analyzed and, if necessary, also stored in a data lake for later data analysis. For this purpose, the data is collected directly on the shop floor, including initial pre-processing in real time. This analysis examines the data for anomalies, for example by running machine learning models for anomaly detection.

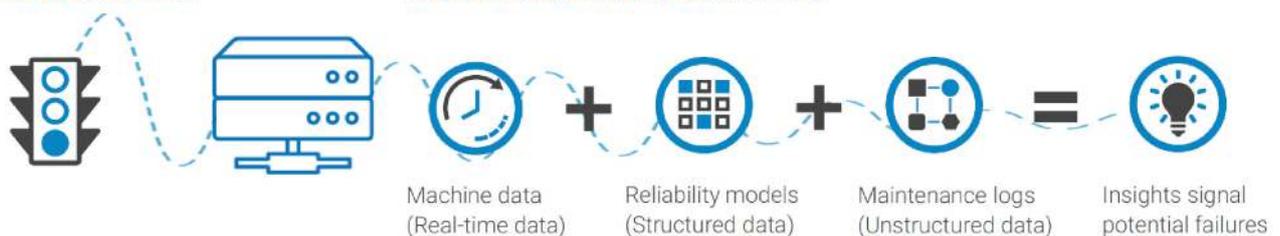
4. Analysis of the data

Both condition-based and predictive analysis are used to identify both maintenance and quality problems. The remaining service life for equipment and components is predicted and the operating condition is monitored to immediately detect potential or existing quality deviations and to immediately change the machine behavior. Since quality defects can occur due to factors unrelated to equipment, materials or environmental issues, the real-time condition can be leveraged to mitigate the impact of quality defects.

The data is then subjected to a thorough analysis on a server and stored in a suitable storage system. Other data sources can be added to the incoming real-time data. These could be external data such as weather conditions, but also internal data from other proprietary data sources such as log files, data warehouses, ERP systems, previous error reports, etc..

Parameters of normal operation to define rules

Optimizing decision-making by systematically applying measurable real-time and historical data





Working with specialists in your field and AI experts from Dell Technologies and/or our business partners, a model is developed that is trained using existing data and applied to new data. This model, which consists of mathematical algorithms, is then used to predict when maintenance is needed.

A visualization of the data helps all parties see the deviations from the target at a glance.

Depending on the situation, the server and/or the storage system can be hosted in the company's own data center or as a virtual unit in a cloud.

Dell, in cooperation with Software AG, offers an end-to-end solution: The IoT platform "Cumulocity IoT Edge" directly integrates the relevant components of the production plant, for example via OPC-UA and other fieldbus protocols or selectively via retro-fit sensors. "Cumulocity IoT Edge" is run on Dell industrial hardware on the shopfloor and offers the functionalities of an industrial IoT platform directly on premises, without having to transfer data to the cloud. Sensor values and measurements can be analyzed in real-time and any machine learning models can be applied where the data occurs - at the edge.

The industrial solution is delivered as an appliance, a combined solution of Dell hardware and Software AG's Industrial IoT platform, guaranteeing a rapid ROI.

"Think big – start small" is the strategy supported by the solution: In addition to rolling out the solution "on-premise" on the shopfloor, it can be extended in the cloud with Cumulocity IoT. For example, local edge instances that collect data from machines and production lines can be managed and analyzed in the cloud in a consolidated manner.

In addition to the integration, analysis and visualization of sensor data, Cumulocity IoT can also alert or trigger actions in the connected applications, such as service management and the ERP system, so that maintenance can be scheduled for the ideal time.

Condition-based & predictive maintenance

Intelligent data analysis in production is successfully realized at SMC: Cumulocity IoT is the easily scalable solution for predictive maintenance, leakage detection and real-time monitoring of energy efficiency.

Reference story

<https://bit.ly/3bILKXq>



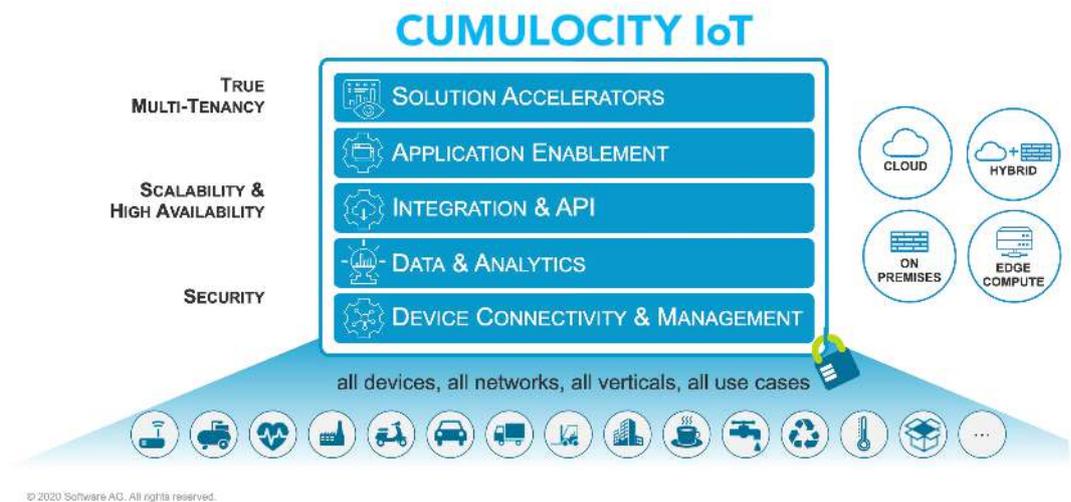
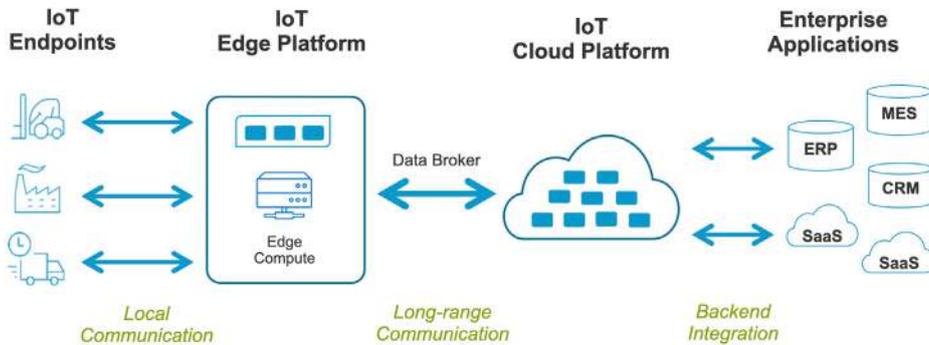
Solution flyer

<https://bit.ly/3q0WGEO>



Options for Implementing a Predictive Maintenance Solution

CUMULOCITY IOT EDGE POWERED BY DELL TECHNOLOGIES



DELL TECHNOLOGIES CUMULOCITY IOT EDGE BUNDLES

Backend Appliance Models				
Size	S	M	L	XL
Server	PowerEdge R340	2x PowerEdge R440 1x PowerVault ME4	PowerStore 1000X	Powerstore 3000X
CPU Memory Storage	1x Intel® Xeon® E-2224 3.3 GHz, 4 cores 32 GB DDR4-2666 4x 960GB SSD SATA	2x Intel® Xeon® Gold 6226 2.60-3.70 GHz, 12 cores 96 GB DDR4-3200 8x 960GB SSD SATA	4x Intel® Xeon® 1.80 GHz, 8 cores 384 GB DDR4-3200 6x 1.92TB NVMe SSD	4x Intel® Xeon® 2.10 GHz, 12 cores 768 GB DDR4-3200 6x 3.84TB NVMe SSD
Cumulocity IoT Software	Cumulocity IoT Edge incl. APAMA Analytics			
Included OS / VMware	vmware ESXi	vmware ESXi	vmware ESXi	vmware ESXi
VMware License incl.	VMware vSphere Standard	VMware vSphere Standard	VMware vSphere Enterprise Plus	VMware vSphere Enterprise Plus

Beyond the pre-implemented and tested appliance consisting of Dell Edge hardware and Cumulocity IoT Edge, Dell Technologies also offers Ready Solutions for AI.

Dell EMC Ready Solutions for AI:

Machine Learning with Hadoop

- Faster, better and more comprehensive data insight with Intel Xeon processors
- Maximum efficiency, security and control
- PowerScale as NAS storage enables the simultaneous analysis of large volumes of data to achieve faster results
- Comprehensive expertise with the experience of Dell, Intel and its technology partners

Deep Learning with Intel

- Complete hardware and software stack with Intel Xeon processors and tools for cluster setup, deployment, monitoring and management
- PowerScale as NAS storage enables the simultaneous analysis of large volumes of data to achieve faster results
- Comprehensive expertise with the experience of Dell, Intel and its technology partners



Ready Solutions for AI

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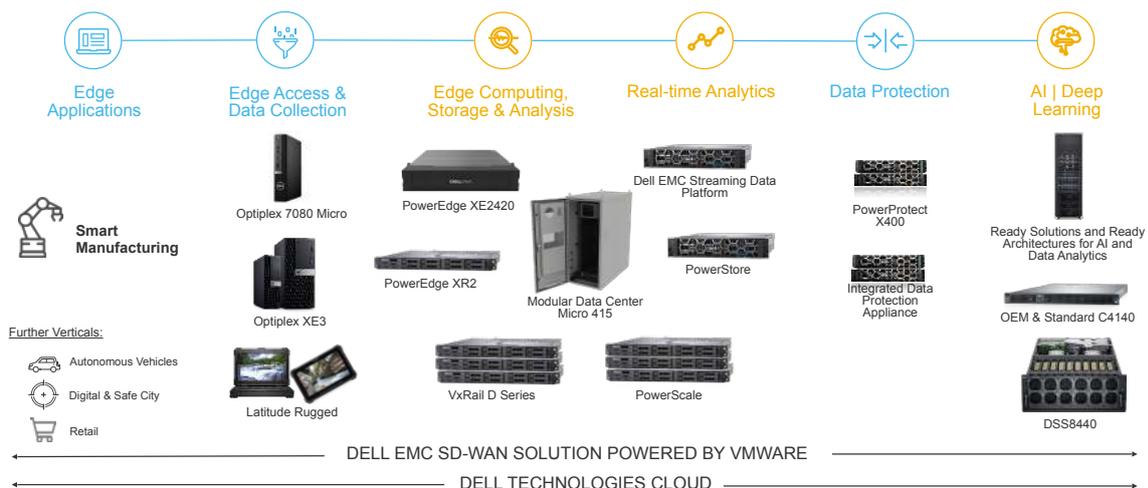


Solutions for AI

<https://bit.ly/3bslyjt>



The products and solutions presented in this scenario are only a sample of the comprehensive Dell Technologies portfolio. Ranging from data collection at the “edge” all the way to real-time analysis on the shopfloor and secure transfer to an ERP system, the customization possibilities are endless when it comes to the Internet of Things (IoT), artificial intelligence (AI) and machine learning (ML). With this portfolio and the in-depth know-how of our experts and partners, we support our customers with the digital transformation of their manufacturing systems.



OEM Solutions

<https://bit.ly/3ijikRC>



Edge & Internet of Things

<https://bit.ly/2Zu1nwr>



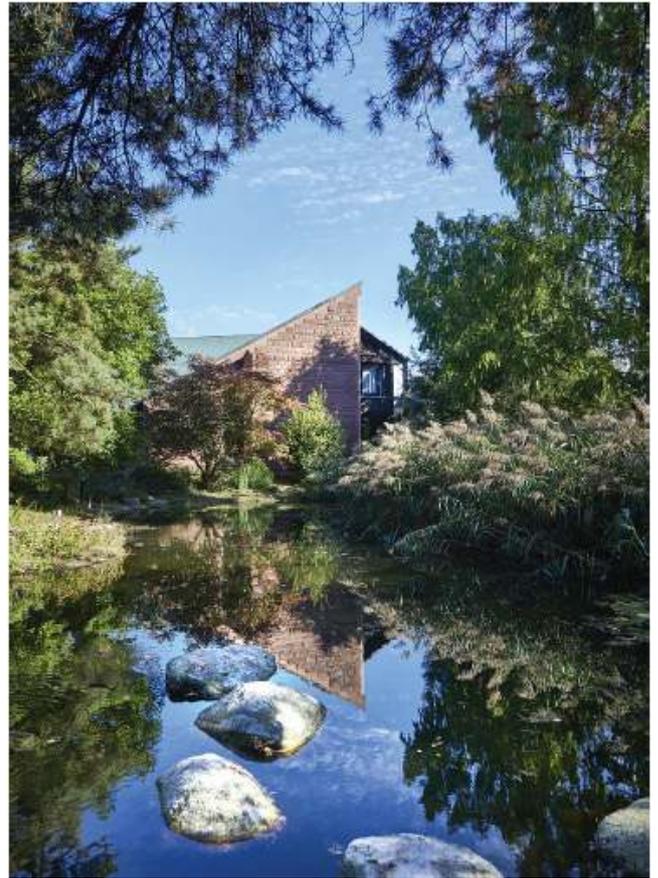
ABOUT OUR PARTNER SOFTWARE AG



Software AG supports its customers in digital transformation. Decades of expertise in software development and IT enables them to deliver the products that suit their customers' needs: With the Digital Business Platform, companies can better interact with their customers, further develop their business models and tap new market potential. Software AG also offers its customers leading solutions in the field of Internet of Things (IoT), enabling them to integrate, link and manage IoT components, analyze data and predict future events based on Artificial Intelligence. Software AG is committed to simplifying the Internet of Things (IoT) and you to integrate innovate in the cloud and on-site.

Software AG

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Software AG Fact Sheet:

Software AG IoT & Analytics

<https://bit.ly/3hdFesb>



Software AG IIOT for Manufacturing

<https://bit.ly/2DLszPD>



If you want to learn more about our partnership with Software AG and/or our solutions, please use this contact form

<https://bit.ly/3bjqrvf>



and we will be in touch as soon as possible.