SHOW BRIEF

Intel IoT
Hannover Messe 2016

Optimizing Assets, Operations, and the Workforce with Smart Manufacturing

According to McKinsey & Company, the value of Internet of Things (IoT) applications in factory settings has been estimated at USD 3.7 trillion per year in 2020.[1]

Smart manufacturing is taking advantage of the Internet of Things (IoT) to converge historically disparate information technology (IT) with operational technology (OT) systems and drive value across the entire manufacturing value chain. This paradigm shift offers an opportunity to tightly integrate siloed business organizations—from R&D, supply chain, and operations/production through customer acquisition and retention—into an enterprise-wide smart manufacturing engine.

How can Intel help manufacturers capture their share of value from IoT? Intel and its broad ecosystem of partners are enabling and advancing smart manufacturing by creating and deploying a sensor-to-cloud IoT platform that is scalable, flexible, and secure. This end-to-end building-block platform utilizes best-in-class hardware, software, and services to digitize, secure, and optimize assets, operations, and employee workflows. The solution can drive efficiency gains and cost savings for real IoT business value. Some examples are predictive maintenance capabilities to increase asset uptime, edge analytics to improve operational decision making, and smart helmets to improve employee efficiency while ensuring the environment is safe for workers.

Potential Benefits

This year at Hannover Messe, Intel and its solution partners will demonstrate how IoT solutions have matured from hype to real-world applications. The showcase will provide examples of how IoT value is being realized in the following areas:

Asset optimization
- Improved operations equipment effectiveness (OEE)
- Increased uptime
- Improved mean time between failures (MTBF) performance
- Lower maintenance costs

Operations optimization
- Flexible and scalable production
- Higher yields and quality
- Decreased production and energy costs
- Improved throughput
- Supply chain agility

Workforce optimization
- Improved safety
- Digitized workflows increasing efficiency
- Greater collaboration and innovation

IOT-BASED SOLUTIONS

Intel has been a leading provider of technology, products, and services to the manufacturing industry for more than 30 years. This includes purpose-built solutions that meet specific industrial-grade, extended product lifecycle, and deterministic requirements of the industry. IoT is now providing an opportunity for manufacturers to evolve their platforms and systems to open, standards-based technologies while supporting their specific requirements around industrialization and determinism. Intel and its partners provide a flexible, scalable, and secure path to this opportunity with a building-block portfolio of processors, chipsets, networking, software, security, and service solutions. Intel is bringing a new level of IoT capabilities to manufacturing.

The following pages describe a few examples of how Intel and its partners are delivering IoT-based solutions that manufacturers can adopt right now to realize the benefits of smart manufacturing.

IoT-Based Solutions for Asset Optimization

IoT asset optimization solutions, built on Intel® processor-based platforms, improve asset utilization, reduce operating expenses, and increase revenue. The solutions accomplish this by connecting dark industrial devices, analyzing the assets data in real time, recommending options, and implementing relevant actions. Designed to integrate information from multiple systems and sources, Intel's asset optimization solutions provide a single point of access to critical data being generated by key assets such as manufacturing equipment and machines, electricity and wind turbines, oil and gas exploration equipment, and other industrial devices. Feeding historic trends and real-time data into predictive models, operations teams can instantly identify maintenance and upgrade requirements before failures occur.

Vibration Analytics Enables Predictive Maintenance

The potential production loss from unplanned downtime drives factory and operations managers to schedule preventive maintenance (PM) routines that are often not optimal. At regular intervals, service engineers run diagnostics, grease parts, and swap out components that wear down, whether they need to be replaced or not.

This demo shows a predictive maintenance solution that offers a more cost-effective alternative, whereby vibration data is used to predict machine failure. A vibration sensor mounted to a crankshaft sends data to the cloud (via an IoT gateway) for analysis by machine learning algorithms. Users can train the system to differentiate between normal wear and problematic behavior for individual pieces of equipment. Maintenance personnel are alerted when equipment failure is imminent. The solution enables a more intelligent and cost-effective maintenance plan.

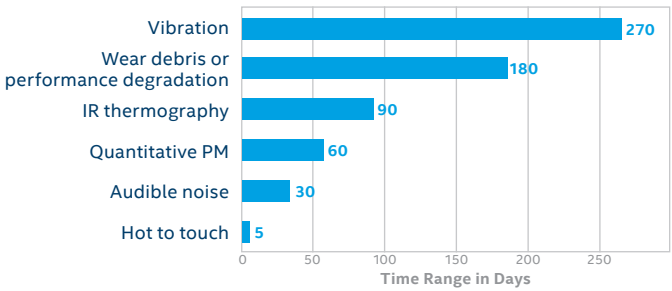

Figure 1. Vibration provides a relatively long advance warning of potential failure, compared to other indicators.
Source: Machine Monitoring Systems machinemonitoring.co.uk/reliability

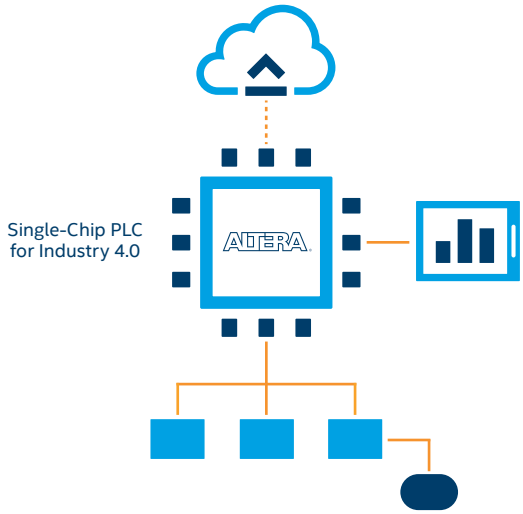

Figure 2. Altera's PLC-on-a-chip reference design connects manufacturing systems to the cloud and an HMI.

Secure, Cloud-Enabled PLC-on-a-Chip Enables Smart Factories

Programmable logic controllers (PLCs) are at the heart of a smart factory control network, and they now connect to the enterprise to enable the Industrial IoT.

The smart factory demo features three coordinated Altera-based PLCs over a time-sensitive networking (TSN) backbone, controlling a delta-robot, RFID reader, and a conveyer connecting to an Intel®-based SCADA HMI and the cloud. It features the award-winning Altera secure, cloud-enabled PLC reference design with OPCUA and TSN. The solution provides the flexibility, low cost, low power, and small footprint needed to quickly develop a complete Industry 4.0-ready PLC with integrated HMI, in a board half the size of a credit card.

Developed in partnership with 3S-Smart Software Solutions, Exor International, TTTech, and Barco Silex, the solution implements various real-time industrial Ethernet protocols, including EtherCAT, PROFINET, and Ethernet/IP over an 802.1 TSN backbone. The solution supports peripherals such as USB, CAN, Ethernet, timers, and UARTs as well as secure cloud communication to the Enterprise with OpenSSL encryption over OPCUA.

Predictive Quality and Maintenance Solution Boosts Equipment Uptime

A high priority for manufacturers is maximizing utilization and performance of their equipment and machines while minimizing costly, unscheduled downtime. This is possible with smart manufacturing solutions that predict when, where, why, and how an asset is failing. Traditional statistical process control (SPC) techniques are no longer effective in predicting poor quality issues. SPC only identifies the problem after it occurs.

The demo shows a conveyor system with image scanning that can be found on a typical factory floor. Sensors capture images and conveyor performance, including measurements on motor performance, heat output, vibration, and resistance levels. The data is analyzed by the ADLINK PMQi end-to-end data analytics platform that includes IBM's Predictive Maintenance and Quality (PMQ) Business Analytics and Vortex Data Distribution Services. PMQi provides predictive perspectives via health scores to the running equipment, and information is presented in a customized user interface. ADLINK's gateways, based on the Intel® IoT Gateway, collect the sensor data.

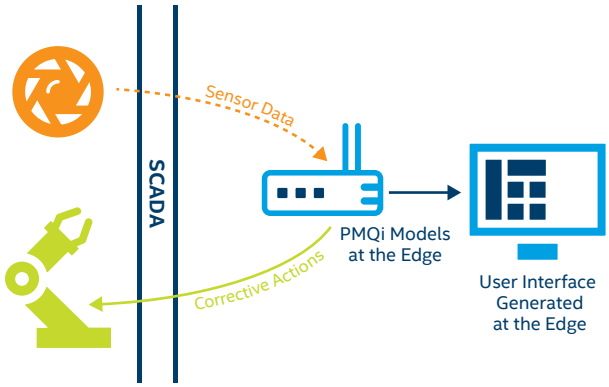

Figure 3. ADLINK's and IBM's predictive quality and maintenance solution detects imminent equipment failure.

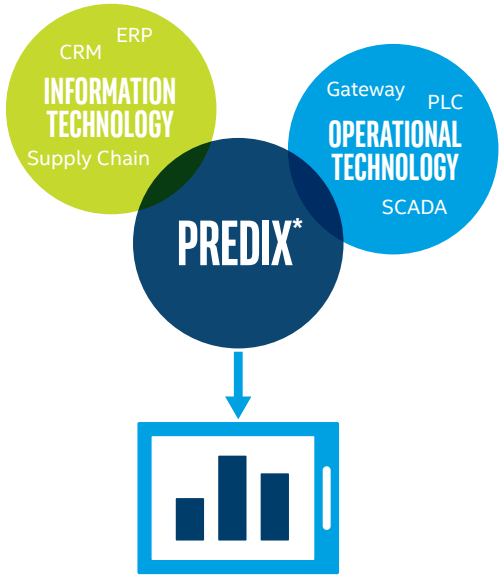

Figure 4. The GE Predix* software platform helps merge OT and IT infrastructure.

Industrial Platform-as-a-Service Minimizes Unplanned Downtime

Every year, USD 20 billion is spent on the maintenance of industrial machines, and massive data is collected—often in silos—about the performance of these assets. Historically, it has been very difficult to store, analyze, and act on this invaluable information to save maintenance costs and improve performance.

That is, until today. Predix*, GE's cloud platform for the Industrial Internet, is an end-to-end platform-as-a-service (PaaS) for developing, deploying, and monetizing IoT applications from the edge to the cloud. The demo shows how the Predix platform is used to collect sensor data from industrial equipment and then aggregate, process, and analyze all sensor data on the edge using Predix Machine*, which is running on a Predix-ready gateway device. Based on the result of the analytics, sensor data is streamed to the Predix cloud using the Predix data service to ingest data into the time series database for advanced analytics in the Predix cloud. Industrial customers can use the results to take action to optimize asset performance and minimize downtime.

Intel Works with Ecosystem Partners to Develop Industrial Equipment

On display are various industrial devices (industrial PCs, PLC/PACs, HMI, gateways, test and measurement, etc.) offered by Intel's ecosystem partners.

IoT-Based Solutions for Operations Optimization

Manufacturers require production agility and visibility across their entire value chain to optimize and drive IoT business value throughout the operation. Manufacturers need to collect, analyze, and extract intelligence from the deluge of data coming from sensors, equipment, and machines. Based on volume, velocity, and criticality of the data collected, it may be more effectively managed at the edge of the network or sent to the cloud. A robust, scalable, and secure end-to-end platform is required. The following demonstrations showcase Intel's sensor-to-cloud platform that enables manufacturers to optimize their operations.

Time-Coordinated Computing Improves Control System Response Time

Many manufacturing processes demand deterministic performance, which requires the supporting systems to receive information and send back responses in a consistent and repeatable amount of time. One example is industrial robotic systems, where an unexpected communication delay (measured in milliseconds) could lead to misprocessed products or even damage to the robots themselves.

To meet the need for fast and deterministic responses, Intel processor-based control systems are designed with time-sensitive networking (TSN) chips. This, along with other time-coordinated computing features built into Intel® silicon, allows the system to respond to sensor input in a deterministic period of time, which includes the delay for networking, MAC/PHY operations, and the interrupt service routine.

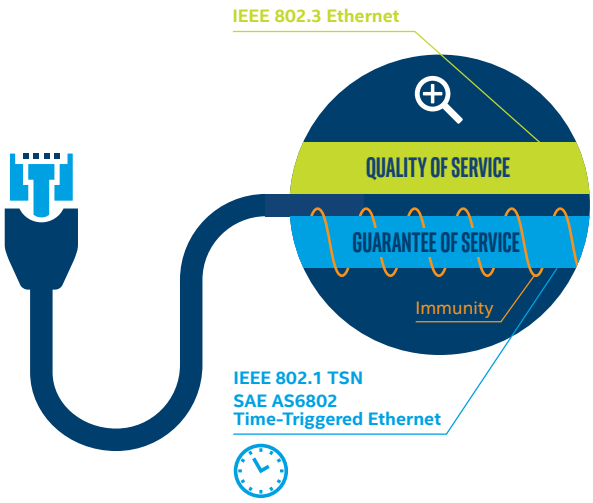

Figure 5. Time-coordinated computing allows time-synchronized, low-latency streaming services through Ethernet networks.

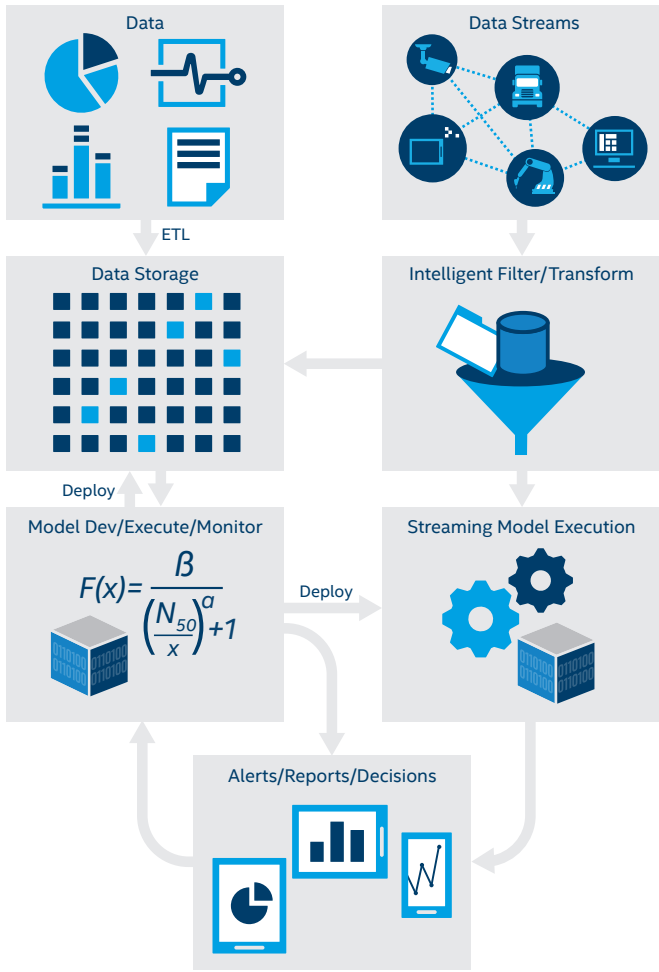

Figure 6. SAS Event Stream Processing predicts asset failures and problems by analyzing streaming data.

IoT Analytics Supports Intelligence for the Connected World

The IoT is having a dramatic effect on manufacturers in all aspects of their business. Connected devices will radically change the way manufacturers manage the product lifecycle and enable new business models.

The demo showcases SAS models running on an Intel platform at the edge and analyzing streaming sensor readings such as motion, light, and sound. As an example, the solution can be used by predictive maintenance solutions to forecast impending failures and generate notifications in real time so issues can be addressed proactively. SAS for IoT applies the power of advanced analytics to high-throughput IoT data so that even the most complex things can be answered at the right time, before the opportunity passes. Whether data generated is machine-readable, human-readable, or a combination of both, SAS scales to analyze millions of events per second, helping users decide what is important to action, what can be ignored, and what should be stored. The solution covers the full analytics lifecycle, starting with data capture and integration, and extending to analytics and deployment.

Connected Assets Improve Utilization and Reduce Operating Expense

As equipment maintenance becomes more complex, asset-intensive organizations are seeking ways to work smarter and reduce their operating costs through the Industrial Internet of Things (IIoT). Connected assets can interact with their environment and pass data along to other smart devices, networks, and applications with results ranging from reduced operating and maintenance costs to improved uptime and production.

The Accenture Connected Asset Management solution empowers companies to proactively manage their assets and make quicker, more-informed decisions through the enablement and unlocking of digital content, edge analytics, and prescriptive actions and alerts. The solution allows for easy integration of business workflows and analytical models, with the scalability to add new devices, systems, and processes as well as role-based visualization for an enhanced user experience. The demonstrated use case is an oil production facility, but the features and possibilities are easily transferable to other industries.

Figure 7. Across industries, maintenance continues to claim a large share of operating expenses.[2]

Software-Defined Industrial Systems Increase Manufacturing Agility

By integrating software into manufacturing processes, software-defined industrial systems enable manufacturers to analyze data in real time and make results-based decisions. Production becomes more fluid and flexible as systems can be reconfigured anytime to modify production sequences at short notice.

This demo shows how control systems can be virtualized, resulting in less physical hardware on the factory floor, as well as the ability to maintain and upgrade existing plant equipment with new features. The solution is based on the Wind River Titanium Server*, an OpenStack and KVM-based virtualization software solution. It is designed to meet "six nines" availability and supports many real-time enhancements to provide deterministic and high-performance behavior of user virtual machines and the network. With interoperable, scalable, and modular architectures, the Wind River Helix* portfolio is well-suited to address the system-level challenges facing the manufacturing sector, such as producing smaller lot size to satisfy customer requests.

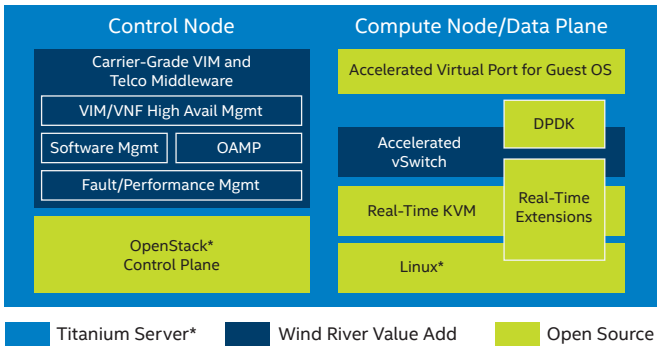

Figure 8. The Wind River Titanium Server* delivers deterministic performance.

Comprehensive Tool Set Simplifies the Migration to Smart Manufacturing

Bringing smart manufacturing to the shop floor requires connectivity among machines, people, and systems. Once this is achieved, it's possible to digitize manufacturing processes across a connected landscape, analyze production data to enable predictive maintenance, and support real-time decisions.

Providing foundational capabilities for IoT-connected factories, Dell offers a comprehensive tool set of hardware, software, and services developed to help manufacturers and systems integrators deploy smart manufacturing solutions. The facilities energy management demo connects a motor and sensor to a Dell Edge Gateway 5000 Series designed to aggregate, secure, and relay data from diverse sensors and equipment. The Intel® Atom™ processor provides capacity to perform local analytics so only meaningful information is sent to the next tier, which could be another gateway, the datacenter, or the cloud. This minimizes consumption of expensive network bandwidth and reduces overall solution latency.

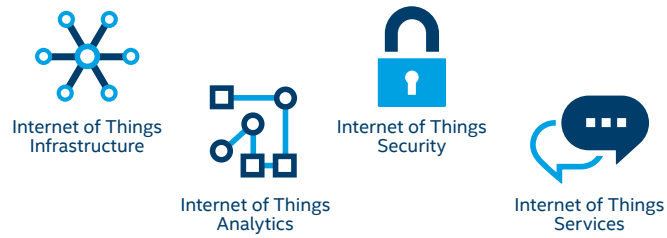

Figure 9. Dell's IoT solution portfolio lowers the risk and increases the speed of deploying IoT initiatives.

IoT-Based Solutions for Workforce Optimization

Manufacturers can increase worker safety and efficiency with solutions that take advantage of environmental awareness.

Wearable HMI Increases Worker Productivity and Safety

Connected wearable technologies are enabling manufacturers to optimize operational efficiency and workflows by capturing and integrating real-time employee and environmental data. Wearable technology is minimizing the non-value-added movement of people by providing relevant and actionable data to workers at the right time to avoid safety hazards and improve efficiency.

This demo shows how and an Intel®-powered DAQRI SMART HELMET* enhances human abilities in industrial settings by seamlessly connecting the user to the work environment while providing relevant, contextual information instantaneously. This wearable human machine interface (HMI) is setting a new standard for industrial, professional-grade wearables and realizes the true potential of augmented reality and 4D in the enterprise space. Powered by an Intel® Core™ m7 processor, the solution integrates various peripherals, including quad microphone array, output audio jack, video and thermal cameras, and two USB expansion ports for adding peripherals. Intel® RealSense™ R200 enables industrial IR depth mapping, 360-degree situation awareness, and other functions.

Figure 10. DAQRI SMART HELMET* provides contextual information in visual and audio formats.

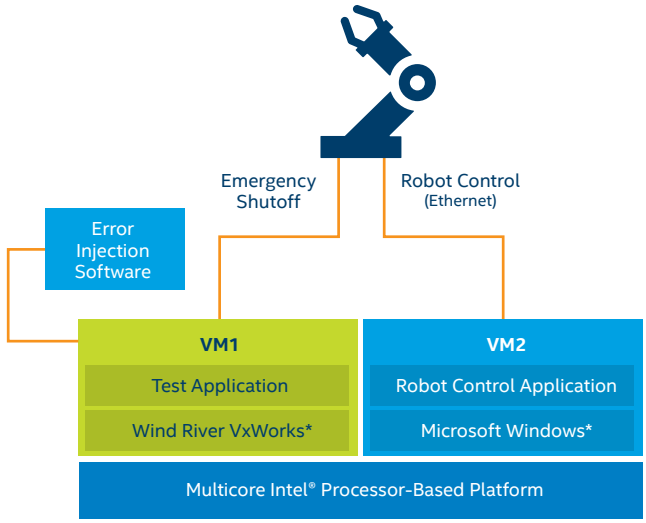

Figure 11. Intel's functional safety solution does not require additional hardware.

Functional Safety Solution Protects Workers

When a manufacturing system malfunctions, it should have a safeguard to prevent physical injury or damage—a concept referred to as functional safety. The safeguard is typically a watchdog function, implemented as an independent piece of hardware or software.

Intel's functional safety solution uses virtualization technology on a multicore Intel processor to run safety-critical software on a dedicated processor core in a virtual machine (VM). The demo shows a robotic arm being controlled by software running on Microsoft Windows* in a VM, along with safety monitoring software running the Wind River VxWorks* real-time operating system. An error is injected in the system, and the safety monitoring software initiates an emergency shutoff. Intel is currently seeking ISO61508 certification for functional safety level 3 and safety integrity level (SIL) 2. Since the solution does not require additional hardware, it saves cost and space, and minimizes development time.

For more information about Intel solutions for industrial applications, visit intel.com/industrial.

1. "The Internet of Things: Mapping the Value Beyond the Hype," McKinsey Global Institute, June 2015, pg. 66, http://www.mckinsey.com/business-functions/business-technology/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world.

2. Wireman, Terry, "Benchmarking Best Practices for Maintenance, Reliability and Asset Management, Third Edition." Industrial Press, August 2014, http://new.industrialpress.com/benchmarking-best-practices-for-maintenance-and-reliability.html.

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