How manufacturers can gain a competitive edge with IT/OT convergence

As manufacturers navigate the challenges of modern production environments, the integration of Information Technology (IT) and Operational Technology (OT) has emerged as a critical strategy.

What is IT/OT convergence?

The modern manufacturing space encompasses two primary segments. The first involves the mechanical components typical of most production plants, such as various machines and industrial equipment used to create tangible products. The second pertains to the operations of advanced digital systems, including servers, storage devices, networking gear, and other technologies essential for running applications, processing data, and making crucial decisions autonomously.

Historically, these two domains have operated independently, exchanging minimal, if any, significant data or control. IT was responsible for data management, communications, and enterprise resource planning (ERP), while OT focused on managing machines, sensors, and industrial control systems (ICS). However, this separation created inefficiencies, data silos, and increased security vulnerabilities.

But the convergence of IT and OT in manufacturing facilities is becoming increasingly prevalent today.

IT/OT convergence refers to the merging of information technology systems that handle data-centric computing tasks with operational technology systems, which oversee monitoring of events, processes and devices to make necessary adjustments in business and industrial operations.

This new paradigm breaks down silos, allowing seamless communication and data exchange between IT and OT environments. Such integration empowers manufacturers to optimize their operations by providing real-time visibility into production processes, enabling predictive maintenance, automating workflows, and ensuring better overall decision-making.

Innovations in technologies like the Industrial Internet of Things (IIoT) and big data analytics are allowing the digital world to observe, comprehend, and impact the physical operation. When executed effectively, IT/OT convergence can unify business processes, insights, and controls into a cohesive environment for much greater business impact.

Components of an IT/OT System

IT/OT convergence in manufacturing relies on several key components that work together to bridge the gap between the physical and digital worlds.

The assortment of connected devices known as the **Industrial Internet of Things (IIoT)**, which includes devices such as sensors, actuators, and connected machines, are foundational to IT/OT convergence. These devices gather data from physical assets such as temperature, pressure, speed, or vibration as they occur, and then transmit the readings to IT systems where it can be analyzed and acted upon. For example, if a sensor indicates a particular piece of equipment is likely to fail, the IT system can trigger a maintenance alert and prevent a larger disruption.

Industrial Control Systems (ICS) are OT systems that control and automate physical processes in manufacturing environments, like Supervisory Control and Data Acquisition (SCADA) systems, Distributed Control Systems (DCS), and Programmable Logic Controllers (PLCs). Through IT/OT convergence, ICS are integrated with IT systems to enable centralized monitoring and control of physical operations. A SCADA system that controls processes on the factory floor can be integrated with an IT network, allowing engineers and operators to monitor machine performance from any connected device in real time.

Data from IIoT devices and OT systems is often stored and processed in the cloud or at the edge of the network, where proximity to the devices enables faster data processing and decision-making for time-sensitive applications. Known as **edge computing**, this latter technique involves processing data locally at the source, reducing latency and enabling real-time decision-making, such as halting a production line when an anomaly is detected. The decentralized nature of edge computing keeps bandwidth usage low, making it possible to have many individual devices using sending data over the network at once.

To gain actionable insights from the vast amounts of data generated by IIoT devices, manufacturers can leverage data analytics and AI technologies. **AI and machine learning (ML)** algorithms can analyze data patterns, predict equipment failures, optimize workflows, and improve product quality. Predictive maintenance systems using AI, for example, can analyze sensor data and forecast when machines are likely to fail, allowing maintenance teams to address issues before they lead to costly downtime.

A unified IT/OT network architecture is essential for secure communication between formerly isolated systems. This requires combining IT and OT networks while preserving security and segmentation to stop potential cyberattacks from spreading throughout the entire network. The use of **software-defined networking (SDN)** enables manufacturers to keep IT and OT data logically separate, even when they share the same physical infrastructure.

Cybersecurity is a critical aspect of IT/OT convergence, as the integration of previously isolated systems increases the risk of cyberattacks. Malware previously confined to IT systems could potentially infect OT systems, and the proliferation of IIoT devices, while essential components, opens just as many entry points to the network. Manufacturers must implement robust, holistic cybersecurity measures that protect the entire network, such as network segmentation, threat detection, and real-time monitoring, to protect both IT and OT environments.

Automation plays a significant role in IT/OT convergence by allowing manufacturers to automate workflows and processes based on data from OT systems. Orchestration tools — such as **Security Orchestration, Automation, and Response (SOAR)** platforms, which can automatically quarantine compromised machines if a cyberattack is detected — enable automated responses to specific events, such as shutting down a process if an anomaly is detected or adjusting production schedules based on real-time demand data.

Key benefits of IT/OT Convergence

The convergence of IT and OT represents the future of manufacturing. And here are a few reasons why.

Real-time decision making
The integration of IT and OT enables continuous data sharing across various systems. This seamless data flow between factory-floor machines (OT) and management-level IT systems allows real-time insights that can optimize production lines, reduce downtime, and increase overall productivity. Integrated systems facilitate increased automation, reducing the need for manual intervention and allowing for optimized resource allocation. This results in quicker, data-driven decision making to quickly address production bottlenecks and prevent delays.

Predictive maintenance
Manufacturing operations make their money on uptime, so it makes sense to maximize what can be produced over the maximum amount of time the plant can run. However, parts wear out — and when they do, they can disrupt operations entirely. Preventive maintenance, then, is practiced across the industry by scheduling downtime so machinery can be cleaned and parts replaced ahead of failure, keeping costly events that take the facility offline from occurring.

Predictive maintenance — basing downtimes on the analysis of data from OT system sensors — takes this concept into the connected era. Real-time equipment monitoring allows businesses to foresee machinery failures and perform maintenance preemptively. By leveraging machine-learning algorithms, a plant can predict component failures based on sensor data, avoiding costly downtimes from unexpected breakdowns and cutting repair costs.

Improved supply chain management
Real-time supply chain visibility enables the tracking of inventory levels, monitoring of supplier performance, and adjustments to production schedules as needed — and that level of transparency is a key benefit of IT/OT convergence. Getting alerts quickly — for example, information concerning a production disruption at a critical supplier — allows manufacturers to adjust production or source alternatives, mitigating adverse impacts. This results in a stronger and more efficient supply chain.

Enhanced flexibility and agility
When IT and OT systems are integrated, a manufacturer can quickly adapt production lines to fluctuating consumer demands or production conditions, reducing lead times for product modifications. This agility supports mass customization, allowing manufacturers to produce tailored products efficiently.

Stronger data security
Traditionally vulnerable due to a lack of robust cybersecurity measures, OT systems benefit from integrated security frameworks provided by IT/OT convergence. Advanced IT threat detection systems extend protection to OT environments, decreasing cyberattack risks, while enhanced network segmentation allows automated isolation of compromised systems, preventing wider network breaches.

Step Into the Future

Despite its advantages, IT/OT convergence presents challenges to the traditional separation of IT and OT teams. Fostering collaboration and developing cohesive strategies for effective implementation will help overcome these challenges.

For manufacturers, adopting IT/OT convergence offers substantial benefits, including real-time decision-making, improved security, cost savings, and the ability to thrive in an increasingly complex industry.

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