Manufacturers can scale edge computing with hybrid cloud

Digital manufacturing requires agility and security

In the midst of Industry 4.0—the fourth industrial revolution—connected, responsive technologies are making enterprise environments more data-rich at edge locations. The traditional manufacturing sector is adopting modern, software-defined practices and automation to facilitate new ways of production, value, and optimization. The successful implementation of emerging Industry 4.0 technologies within the manufacturing stream increases the visibility of processes, allows organizations to adapt quickly to market changes, and delivers competitive advantages.

"Many manufacturing companies are seeing an increase in cyber-related incidents associated with the control systems used to manage industrial operations."

Deloitte
"Cybersecurity for smart factories: Tools for managing cyber threats to manufacturing"

The convergence of information technology (IT) and operational technology (OT) is a cornerstone to Industry 4.0 adoption, moving toward an intelligent enterprise. With edge computing, the intersection with IT extends several key benefits to OT including:

- Globally scalable operations and automation of advanced Day-2 operations.
- Internet of Things (IoT) data integration to cyber-physical systems.
- Effective and efficient data analysis closer to the source.
- On-premise artificial intelligence (AI) infrastructure for near real-time predictive analytics.
- Advanced software-defined, low-latency communication and network technologies.
- Hybrid cloud computing that integrates data lakes and advanced data analytics.
- Hybrid cloud DevOps pipelines for continuous deployment to the edge, lowering the cost of maintenance while improving capabilities and performance.

This shift toward automated, data-centric operations promises tremendous opportunities for innovation, efficiency, and growth and minimizes risk with predictable and repeatable operations. However, there still are concerns to be addressed to further limit the risks associated with these new edge capabilities. For example, cybersecurity is a significant challenge associated with IT-OT convergence. Until now, OT components existed offline in factories, as security focused mainly on the physical separation of networks. Integrating OT into an IT network changes the cyber landscape and opens factory operations to digital threats.

Another aspect of integrating OT into the IT network is the heterogeneous nature of OT systems. These are usually custom-built, with each use case bringing its own infrastructure to the floor. This means that manufacturing enterprises often have aging, uncommon, or variable infrastructure in their plants, presenting an obstacle to consolidating OT onto modern IT platforms to deliver business value.

Red Hat equips manufacturers to converge IT and OT at scale

As Industry 4.0 becomes a reality, enterprises that want to maintain or increase their competitive advantages must take action to align their technological capabilities with the new environment. The question for most manufacturers is not whether to shift toward automated, data-centric

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operations but rather how fast they can do it. Organizations also want to know how to sync IT and OT at scale—securely—in a workplace where staff skilled in both OT and cybersecurity disciplines are scarce.

Red Hat helps manufacturers strategically modernize and merge their IT infrastructures with OT systems. To manage and scale new smart factory workflows, Red Hat provides guidance, technology, and infrastructure to build data and event-driven systems. Among other capabilities, these features help:

- Support automated manufacturing.
- Refine robotics and improve product designs using data analytics.
- Create machine-to-machine communications (Figure 1).

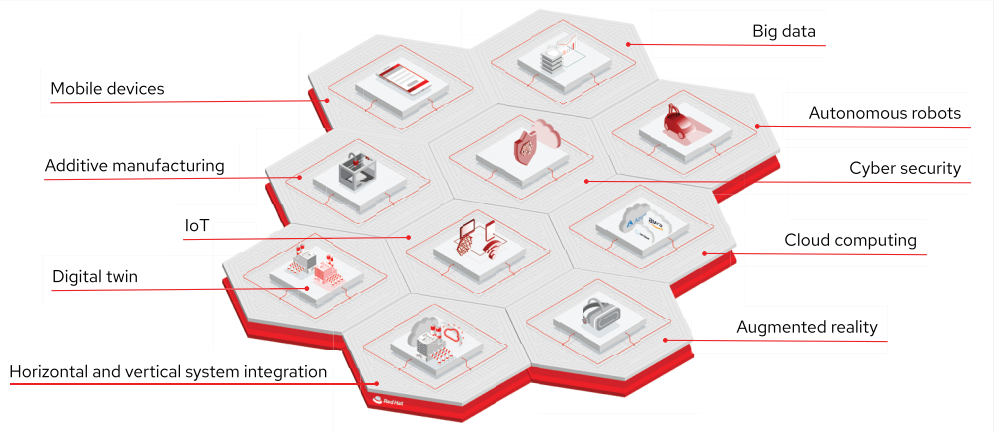

Figure 1. Red Hat's open software provides the infrastructure to support and scale Industry 4.0 capabilities.

Manage manufacturing processes more efficiently with edge computing

In conventional manufacturing environments, data is often collected locally on isolated and proprietary closed-loop systems that are not integrated into an organization's core analytic systems. Extracting relevant information is typically handled via a batch process, or even manually, and sent to a central location for further analysis. This assumes the ability to export the data even exists.

Fundamental capabilities of real-time, data-driven operations—such as predictive analytics and fully automated systems—require access to the information stored on these isolated closed-loop systems to create an aggregation of actionable data. In the early stages of Industry 4.0, solutions integrated OT data streams to cloud providers' systems, which then pushed data storage, analysis, and decision-making to centralized processes. While this approach made financial sense for early adopters—who were looking to take further advantage of low cost and prevalent compute power—relying on centralized systems instead of provisioning compute power locally made it difficult to scale these operations.

One of the key concerns when scaling out Industry 4.0 capabilities is that many factories operate as closed-loop systems. Despite this, they must deliver high levels of availability for both off- and on-site connections, which is not possible when solely dependent on either remote or cloud operations. The introduction of high latency loops into factory-floor systems raises another concern. For small data streams, these loops may be appropriate, but they are in no way designed for advanced capabilities like video or photo analysis, a limitation that compromises expected gains for such use cases.

To mitigate both of these concerns, Red Hat has developed advanced open hybrid cloud technologies used to harness compute capabilities anywhere at any time. This includes modern edge computing capabilities which allow a vendor-agnostic hybrid cloud to span to the factory floor, improving uptime in latency-sensitive systems. With edge architectures fully integrated into an open hybrid cloud, manufacturers can run smart factories. With secure data-aggregation from sensors, controllers, and robotics in operation today, analysis performed closer to the data source can deliver actionable information in near real time.

Consider the hundreds or thousands of factory components currently deployed that are collecting and processing data. With edge computing, industrial enterprises have an unprecedented level of visibility into their plant systems and resource behaviors. As part of an open hybrid cloud strategy, that visibility offers the opportunity for significant process improvement and, ultimately, a competitive advantage.

For example, in OT environments, when a hydraulic system reaches an over-pressure threshold, the system is shut down by its automated safety module. This level of automation is considered an Industry 3.0 behavior. Edge computing provides a greater capacity for intelligence to slow down the usage of the system to finish a batch or even reconfigure the machine to avoid shutting down, increasing the overall equipment effectiveness. And this is for a single process.

Manufacturing processes can include multiple sub-processes, as seen with automotive light production, which includes modeling, lighting, and assembling. An integrated edge computing environment with Industry 4.0 capabilities can monitor all these subprocesses in real time and prompt behaviors such as speed adjustments, alerting maintenance, and—when necessary—shutting down the entire end-to-end production process. Additionally, this introduces the ability to integrate and adjust the behavior of external processes such as the supply line where the degraded process initiates alerts to slow the delivery of parts to the impacted system.

This scenario assumes the system only incorporates data from the process's integrated components. When built with Industry 4.0 capabilities, edge systems can pull in data collected external to the typical OT systems such as power draw, air quality (e.g., ozone detection), worker safety, and more to gather a more complete picture of the factors affecting OT processes and react accordingly.

Edge computing allows a more robust use of automation on the plant floor, equipping systems to make decisions in real time and control factory systems at the source. For example, an edge node can proactively adjust the output of a generator to prevent an over-loading down the chain. Automated actions such as this—multiplied across many nodes in multiple factories—can provide significant operational benefits.

Red Hat simplifies the convergence of OT and IT with management and automation

Red Hat supports edge computing with a platform and ecosystem focused on making operations simpler through automated provisioning, management, and orchestration. This approach helps to establish a common infrastructure that stretches across workload needs, including computing, storage, and networking. Additionally, as edge computing sites often have limited or no IT staffing, Red Hat® solutions can be centrally managed using the same tools and processes as the centralized cloud infrastructure, even in cases with limited, intermittent, or no connection, such as oil rigs or vehicles.

Hybrid cloud: Fundamental infrastructure to integrate edge computing

In a smart manufacturing environment, an edge deployment could consist of hundreds of thousands of sensors connected to a data-aggregation tier. This architectural model provides real-time feedback to the processes that the sensors are monitoring. However, managing each of these connected devices would not be feasible unless they shared a consistent control plane. Connecting these devices to hybrid cloud infrastructure provides consistency from edge devices to the network to the centralized datacenter, converging OT and IT and providing a common foundation for all of these components. This allows IT teams to manage tens of thousands of networked devices just as they would their centralized IT.

Red Hat OpenShift® extends the capabilities of Kubernetes to the edge of the network, supporting a "develop once, deploy anywhere" operational model. Its flexible set of topology options allows consistent operation across sites that can vary in size, location, or environment. This makes it feasible to address the specific needs of the complete edge architecture, allowing placement of applications where it makes most sense to the business—even in the most remote locations. Manufacturing enterprises can benefit from a DevOps approach in which the same tools and applications allow developers to deliver the latest capabilities at scale and help IT operations maintain consistent control, visibility, and management of hundreds to thousands of edge nodes.

Stability and uptime are crucial in the OT world—a production line outage can cause severe financial damage. Red Hat OpenShift brings the resilience of modern cloud technology to the factory floor.

Red Hat Enterprise Linux is ready for the edge

The edge is an extension of the datacenter footprint beyond the bare-metal, virtual, private cloud, and public cloud environments that contain centralized infrastructure. In a sense, edge computing merges these four, blending pieces from each to create an infrastructure built to satisfy specific customer demands that centralized IT models cannot address.

The small physical sizes, remote locations, and limited connectivity of edge devices pose hurdles for traditional, full-featured operating systems. Starting with Red Hat Enterprise Linux® 8.3, manufacturers can address these challenges with an operating system that can be used from core data centers to space-constrained remote servers. Red Hat Enterprise Linux is also built to provide the levels of supportability and stability that enterprise manufacturing edge deployments require.

With years of proven performance in datacenter deployments, Red Hat Enterprise Linux brings enterprise-grade cyber security to edge systems. Edge-focused features of Red Hat Enterprise Linux include:

- **Rapid creation of operating system images for the edge** through the image builder capability. This allows IT organizations to more easily create purpose-built images optimized for the broad architectural challenges inherent to edge computing but customized for the exact needs of a given deployment.
- **Remote device update mirroring** to stage and apply updates at the next device reboot or power cycle, helping to limit downtime and manual intervention from IT response teams.
- **Intelligent rollbacks** built into multiple layers of the architecture—from the underlying operating system through to the applications and application services. This capability equips users to perform health checks specific to their workload deployment to detect conflicts or code issues. When a problem is detected, the change is automatically reverted to the last healthy state, helping to prevent unnecessary downtime at the edge.
- **Role-based access** that limits the people that can access and have administrative rights to the system, maintaining security at edge deployments.

An ecosystem for well-rounded edge capabilities

Beyond the capabilities within its portfolio of hybrid cloud technologies, Red Hat also maintains an extensive partner ecosystem for complete enterprise-grade edge deployments. Software partners allow edge capabilities that integrate uninterrupted into the edge network through Red Hat OpenShift, including:

- Predictive analytics on IoT data in real time using artificial intelligence and machine learning to improve efficiency, availability, and profitability.
- Visibility that allows manufacturers to manage and operate highly distributed solutions across hundreds of thousands of devices and endpoints more securely.
- Industry-specific vertical solutions like Manufacturing Operations Management (MOM) and Supervisory Control and Data Acquisition (SCADA).

Red Hat also works with hardware partners to meet the needs of manufacturing plants in the edge network. For example, for operational technology teams that have concerns about physical security, Red Hat's collaboration with Intel can provide hardware-based Secure Boot functionality. Collaborations with hardware original equipment manufacturers (OEMs) like Siemens provide rugged industrial PCs designed for harsh environments—like a factory floor or oil rig—and certified for Red Hat Enterprise Linux and Red Hat OpenShift.

The open source advantage

Red Hat cloud computing, application development, virtualization, and storage solutions power new manufacturing processes, more efficient supply chain operations, and edge computing capabilities.

To stay competitive as Industry 4.0 technologies become more common, manufacturers need solutions that facilitate autonomous decision-making processes that can monitor assets and processes in real time. The Red Hat open source approach equips manufacturers with real-time, connected value-creating networks through early and vertical and horizontal integration.

Red Hat's hybrid cloud solutions support modern, flexible, interoperable manufacturing and supply chain systems by embracing open source innovation, solving enterprise challenges, and building solutions with best practices spanning information technology and operational technology.

Red Hat's validated patterns provide a complete architecture pattern, including code, for automated deployment and Day 2 operations at both the datacenter and smart factories. Backed by Red Hat Quality Engineering, the patterns are continuously tested to ensure future reliability.

Build your smart factory on best practices and open technology

Red Hat OpenShift, Red Hat Enterprise Linux, open hybrid cloud architectures, and key open community, software, and hardware partners play an important role in the emergence of Industry 4.0 and the digital transformation of manufacturing. This unique approach makes it possible for IT and OT staff to rapidly develop and deploy digital innovation at scale with security, reliability, and visibility.

To learn how to deploy modern edge computing in hybrid cloud environments at scale and in less time, check out Red Hat's approach to edge computing for manufacturing.

About Red Hat

Red Hat is the world's leading provider of enterprise open source software solutions, using a community-powered approach to deliver reliable and high-performing Linux, hybrid cloud, container, and Kubernetes technologies. Red Hat helps customers develop cloud-native applications, integrate existing and new IT applications, and automate and manage complex environments. A trusted adviser to the Fortune 500, Red Hat provides award-winning support, training, and consulting services that bring the benefits of open innovation to any industry. Red Hat is a connective hub in a global network of enterprises, partners, and communities, helping organizations grow, transform, and prepare for the digital future.

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