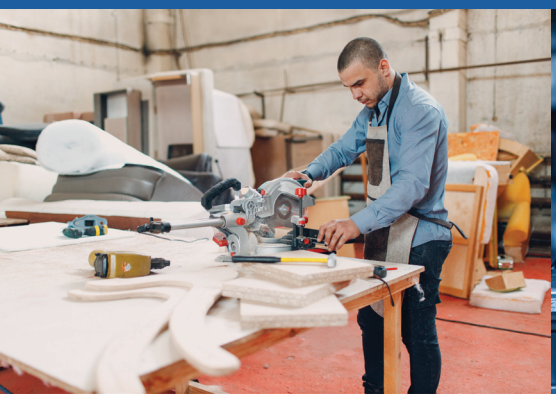
Modern Edge Computing Accelerates Smart Manufacturing Initiatives for Discrete Manufacturers



OT and IT teams are deploying continuously available, zero-touch Edge Computing infrastructure, transforming operational data to enhance productivity and drive reliable, efficient operations with less cost and less risk.

Stratus

Automation is improving the overall productivity of discrete manufacturing plants and facilities, delivering a range of goods from automobiles and electronics to furniture and toys to countless other items. The complexity of coordinating personnel, work procedures, material handling, and automated equipment – all while meeting production goals – make increasing digitalization and use of data across the enterprise and in production essential. Perhaps most important is the ability to put the control engineer, line worker, and design engineer in the middle of this critical data to derive actionable insights and provide real-time decision support. The constantly growing capabilities of digital technologies are creating more opportunities for discrete manufacturers to drive increasingly reliable and more efficient operations.

Smart manufacturing encapsulates the use of sensors and entire systems that have become more intelligent, with increased networking and vast amounts of available data. Industrial internet of things (IIoT), Industry 4.0, and digital transformation are a few of the principal trends describing the ubiquity of devices and the increased connectivity to those data sources in the manufacturing environment. Add in advanced analytics and discrete manufacturers can capture crucial insights that inform users on how to improve operational efficiency and reliability. First, manufacturers need to capture critical operational data reliably and process it locally without latency in the face of bandwidth constraints. This is driving the need to deploy computing power – Edge Computing – into environments close to critical equipment and processes, such as the factory floor or on a machine or production line.

Whether the need is to improve the intelligence of a single machine, a production line, an entire factory, or enterprise operations, resilient and future-proof Edge Computing infrastructure is essential for discrete manufacturing companies. Edge Computing is a foundation for pursuing smart manufacturing or digital factory initiatives. In this context, Edge Computing platforms must be engineered to provide the highest level of reliability, easy manageability, and operational lifespan that manufacturing environments require.

This whitepaper discusses the challenges discrete manufacturers face when implementing smart manufacturing and how simple, protected, and autonomous Edge Computing platforms are a requisite to solving production challenges, accelerating digitalization, and establishing reliable infrastructure that supports Industry 4.0 software and applications.

Smart manufacturing challenges for discrete manufacturers

Taking the next steps toward optimized smart manufacturing provides numerous benefits, but also represents a commitment of talent and cost. Below are some of the most prevalent challenges faced by manufacturers implementing digital transformation.

- **Deploying a modern manufacturing software stack:** Discrete manufacturers are deploying a modern manufacturing stack with a range of software applications that connect PLCs with HMI/SCADA and DCS systems to improve performance and create visibility across the operation and enterprise. Smart manufacturing stacks also incorporate asset performance management (APM) strategies, digitalization of manual workflows, and integration with supply chain management, warehousing/material handling, enterprise resource planning (ERP), and other specialized applications that require production data without interruption. Smart manufacturing requires computing infrastructure that helps seamlessly connect these applications to enable data capture, processing, and sharing in near-real-time.

- **Standardization and scalability:** Most manufacturers have accumulated a broad range of applications and equipment, whether from investing in custom hardware and software or from acquiring assets over years of operation. This creates disparate elements and "islands of automation." These organizations know the pitfalls associated with this approach, including high development costs, unreliable and hard to manage operations, and cybersecurity risks. Bridging these systems, adding new capabilities, and achieving operational efficiency requires standardized data and architectures that can easily scale across the entire operation.

- **Maintenance and support:** Maintenance and support are multifaceted considerations, especially when adding new solutions to support smart manufacturing. With disparate systems and legacy infrastructure, breakdown or failure is common, leading to costly production losses and unplanned downtime. Many manufacturers use data and visualization to perform maintenance, although these fixes may not come quickly, with limited resources and on-site staff capable of making those repairs. Data and the adoption of APM at the edge can help that staff get ahead of these breakdowns and failures.

- **Cost and complexity:** While operational technology (OT) teams hesitate to change processes or equipment due to risk, they face the equal challenge of cost justification and how to support future complexity. This is also a hurdle for their counterparts in information technology (IT) where modernization or other initiatives can risk disruption to operations. Both teams are focused on solution efficiency, simplicity, and cost-effectiveness at all phases of design, deployment, operation, and support while ensuring critical capabilities – such as automation and control – are always available.

- **Cybersecurity:** Smart manufacturing entails greater connectivity among plant floor automation systems and devices, and to higher-level on-premises and cloud-based computing assets. Connectivity is usually a key part of implementing data aggregation, visualization, and analytical projects, whether over a private or public network. As a result cybersecurity concerns are paramount in edge locations where deployment of more OT and IT assets – combined with connected access – increases the number of systems to be protected from cyberattacks.

- **Availability of IT skills in operations:** Companies of all sizes recognize the need to adopt smart manufacturing practices as they modernize. In fact, Gartner reports that "67% of industrial discrete manufacturing respondents stated having a dedicated organization for smart manufacturing (although most report skill shortages)" (Reference 1). These skill shortages compound the other smart manufacturing challenges discrete manufacturers face — manufacturing stack integration, standardization and scalability, maintenance and support, cost and complexity, and cybersecurity.

Although the challenges listed above seem intimidating, manufacturers have successfully managed them and achieved smart manufacturing improvements by leveraging reliable Edge Computing platforms.

Edge Computing is foundational to solving smart manufacturing challenges

Discrete manufacturing is complex, with many moving parts to track, ranging from multiple departments and personnel to vast amounts of critical data, technology, and equipment. Leveraging a simple, protected, and autonomous Edge Computing platform enables manufacturers to meet the digital transformation demands of smart manufacturing. An Edge Computing platform helps organizations to:

- **Eliminate unplanned downtime and maximize availability:** Modern Edge Computing platforms deliver a combination of built-in fault tolerance, supportability, and manageability to run mission-critical manufacturing applications without downtime. Fundamentally, this capability is essential for manufacturing success as well as smart manufacturing applications that rely on data from the factory floor. Beyond application and system reliability, Edge Computing allows for the reliable collection, organization, and processing of data to support operations. This includes support for automation and control as well as APM and condition monitoring to ensure equipment that is physically or geographically difficult to service is visible and available.

- **Seamlessly deploy and integrate a modern manufacturing stack:** Built to run at or close to the edge of operations, often in harsh and/or remote environments, Edge Computing platforms have cohesive, real-time access to data sources and can be deployed throughout an operation, increasing both processing power and overall availability. By connecting manual workflows, ERP systems, HMI/SCADA, PLCs, supply chain management, production equipment, machinery, and more, Edge Computing platforms are ideally situated to aggregate, collect, and analyze vast amounts of big data sourced from the plant floor. They then efficiently preprocess it and communicate the resulting information to higher-level IT-based enterprise systems improving efficiency, productivity, and visibility in discrete manufacturing operations.

- **Simplify, standardize, and scale deployment:** Many discrete manufacturers do not just have one manufacturing facility, but many. Implementing a simple, reliable, and scalable Edge Computing platform provides a unified framework for developing, deploying, and managing smart manufacturing solutions across the organization. Using a standard platform with the ability to pull reusable profiles to additional platforms, engineers now have a standardized way for achieving seamless connectivity and data exchange among diverse components, whether on a single OT machine, or spanning dozens of installations across a multi-site implementation.

- **Achieve KPIs and reduce total cost of ownership (TCO):** Edge Computing platforms provide the required reliability with built-in redundancy, while simplifying maintenance and support of essential infrastructure. This translates to improvements in overall equipment effectiveness (OEE) and production goals as well as less cost and complexity. Using simple, protected, and autonomous Edge Computing platforms, discrete manufacturers achieve a lower total cost of ownership (TCO) as they modernize and future-proof their operations, while increasing OT and IT productivity.

- **Adhering to IT security standards:** Edge Computing platforms that meet your IT security standards provide an additional layer of defense against cyber threats by keeping important data within the manufacturing facility while safely bridging IT and OT networks. Developers can still establish secure connectivity to external resources using proven communications protocols and methods designed for this purpose, such as OPC UA over a virtual private network (VPN). Another tool for protecting data is keeping source data on-site – with an Edge Computing platform – and transmitting just what is needed. Additionally, a trusted Edge Computing platform can run locally modern cybersecurity solutions to further protect aging OT assets effectively.

Discrete manufacturers greatly benefit from leveraging Edge Computing platforms to spearhead smart manufacturing efforts. This is especially true for organizations with multiple manufacturing sites and locations. Rolling out a reliable and scalable Edge Computing platform – or multiple platforms – to ensure global standardization helps companies attain smart factory initiatives.

Bridging the gap between OT and IT

Historically, there has been a gap between OT and IT. More recently, digitalization of discrete manufacturing environments involves these two distinct, yet related domains, especially as smart manufacturing and digital transformation efforts have become increasingly necessary.

End users, OEMs, and SIs have expended significant effort to customize, integrate, and support OT/IT solutions. In recent years, Edge Computing has emerged as an essential intermediate technology, effectively bridging and overlapping both OT and IT environments.

OT personnel in discrete manufacturing must be able to focus on OT tasks – from equipment operation, maintenance, and testing to process optimization, machine and process health, and safety and compliance. However they are often at risk of playing an IT functional role troubleshooting industrial PCs or aging servers.

They additionally must work with IT counterparts to select manufacturing applications and capabilities to progress operations and deliver value.

Conversely, IT personnel well-versed in network infrastructure, cybersecurity, software and system integrations, and data analytics often lack the insight of running OT and the factory floor.

IT expertise is valuable to the deployment of infrastructure for operational requirements. An area of intersection is often associated with control rooms and enterprise servers, which are the IT foothold in the OT world. IT benefits OT by bringing its skillset and tools, including cloud services, to the manufacturing environment.

Although different, these domain priorities are intertwined with one another – the combined expertise of both OT and IT enable integrations between new software and OT production processes as well as improved data-driven decision making, which in turn enhances productivity.

Industrial hardware, software, and communications technologies have improved greatly over the past decades, but standard OT-based products have fallen short as complete smart manufacturing solutions. Greater data connectivity and processing capability is needed at the edge to support both OT and IT smart manufacturing roles, including:

- Unified connectivity with OT and IT devices, new and old
- Data aggregation, storage, contextualization, and pre-processing
- Improved operator visualization experiences, especially when using mobile devices
- Remote access for support of equipment by specialists, regardless of where both are located
- Hosting analytics and applications for determining key performance indicators (KPIs), overall equipment effectiveness, asset utilization, production performance, predictive maintenance, and more

Edge Computing platforms are filling these roles by providing a reliable, easily supportable, and OT-capable solution in a compact form factor. Edge platforms meet the IT-based computing, communications, and cyber standards needed to overcome challenges and create truly smart manufacturing solutions.

Edge Computing benefits and use cases

A modern Edge Computing solution must be much more than an off-the-shelf server installed on the plant floor and more convenient to use than a complex server configuration in a data center. Instead, edge applications demand fit-for-purpose hardware with native redundancy suitable for the plant floor or on-site data cabinets. Provisions for managing these platforms must be comprehensive yet easily used by site personnel. Virtualization is also key for deploying the variety of applications needed for smart manufacturing and should be readily available.

Discrete manufacturing specifiers and designers should focus on Edge Computing platforms with redundancy, management, and virtualization provisions to deliver the simple, protected, and autonomous computing needed to overcome smart manufacturing challenges and deliver valuable results.

Many digital transformation implementers focus on two main technical aspects of the task:

- The ability to rapidly modernize in a future-proof fashion for optimized operations
- The reliability and serviceability of the solution and the production equipment it serves

Here are a few use cases highlighting the previous points:

Production monitoring and control: One of the most common initial uses of an Edge Computing platform is to improve the monitoring and control of one or several machines. With built-in system redundancy, modern Edge Computing platforms are ideal for many tasks – collecting data from PLCs, sharing HMI information via thin clients, and monitoring multiple systems or production lines. Edge Computing is an ideal way to run HMI/SCADA applications near equipment for responsive, low-latency, real-time monitoring. Edge platforms also have computing and networking capabilities to extend this experience to mobile users.

Another rising trend for discrete manufacturers is the increasing production of customized or build-to-order products, some with small production runs. This bucks the historical trend of high-volume/low-variability production and, in years past, the manufacturer would need to implement many complex and costly manual procedures to add variation to production runs. Today, modern digital automation supplemented with Edge Computing provides the flexibility needed to define, implement, and track these variations efficiently.

Connection to manufacturing execution systems (MES): As discrete manufacturers become more sophisticated, Edge Computing platforms provide a bridge between PLCs and SCADA systems to higher-level manufacturing execution systems (MES), extending monitor and control and creating an integrated manufacturing stack. This includes both operational and support efforts for not only the production line equipment, but also for upstream and downstream connections to material supplies and packaging or warehousing.

An Edge Computing platform provides the connectivity and application availability to act as a production line coordinator for a single line, multiple parallel lines, or for multiple serial lines that can be consolidated into fewer lines. While each piece of equipment or production line may already run well in a localized manner using a PLC, it takes a supervisory application that is always available to recognize the big picture and orchestrate operations on a greater scale. High availability and fault tolerant Edge Computing platforms ensure these applications are always on.

Furthermore, because the Edge Computing platform can connect to an entire fleet of equipment, asset management – such as predictive maintenance and energy management efforts – can be expanded far beyond a per-machine model. This oversight allows users to gain information on how each type of machine can and should work so best practices can be applied across the fleet, while spotting and addressing any issues with underperformers.

When paired with application virtualization – the ability to run multiple applications concurrently within an Edge Computing platform – discrete manufacturers are able to rapidly deploy layers of software, backed by fault tolerance, to simplify operations while gaining operational efficiencies. This workload consolidation provides a streamlined and cost-effective path forward and quickly modernizes manufacturing operations.

Enabling edge-to-cloud data architectures: Discrete manufacturing companies operating at the highest levels of excellence optimize the entire value chain. This goes beyond the performance on the production line and includes coordinating all aspects, from the machinery and equipment on the plant floor, to the local data center, up to the cloud or global data center. (Figure 1).

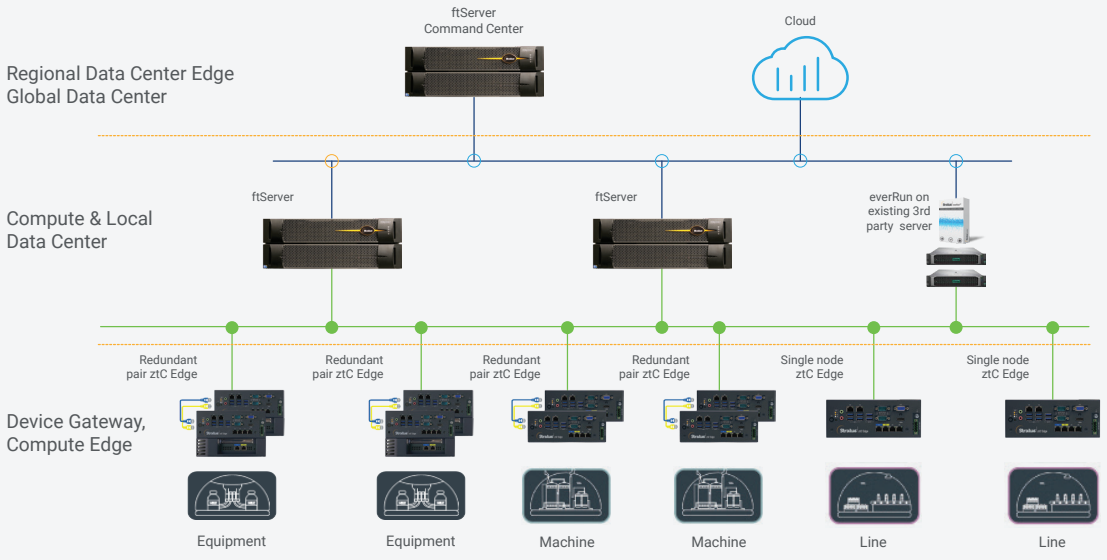


Figure 1: To implement an edge-to-cloud smart manufacturing architecture, Stratus offers the ztC Edge and ftServer redundant computing families, which provide a completely scalable, readily deployed, and easily managed Edge Computing infrastructure so users can create and grow their smart manufacturing solutions.

Rising above plant-centric viewpoints and establishing connectivity with manufacturing execution systems and ERP systems is a particularly good application for Edge Computing. Data is gathered and stored on-premises, increasing data security. Preprocessed information can be transmitted to supervisory systems – which might be in an on-premises data center or in the cloud as needed – minimizing bandwidth needs and providing store-and-forward data integrity in the case of intermittent connections.

Edge Computing platforms are also the high-performance approach for hosting other production-adjacent applications. Examples include quality control, regulatory asset management, and compliance monitoring and reporting systems.

Discrete manufacturers are modernizing with Edge Computing

Enterprises looking to optimize operations need to implement data-driven smart manufacturing, which is almost impossible when using a patchwork of custom and partial solutions.

End users need a comprehensive and user-friendly Edge Computing platform to support these efforts, one that is scalable so they can start with a single installation, and then scale it up to extend successes. Therefore, Edge Computing platforms must be:

- **Simple:** Easy to deploy, install, manage, and scale up over time, and designed with a zero-touch approach.
- **Protected:** Robustly built for reliable operation in field environments, with native redundancy to reduce operational and financial risk.
- **Autonomous:** Deliver constant availability, both for the hardware itself and the applications it runs, with extensive remote management provisions.

For leaders in the complex discrete manufacturing environment, Edge Computing platforms bridge OT and IT so they can realize the full benefits of digital transformation and smart manufacturing. Stratus Edge Computing platforms meet this need for both the production floor and the data center, and are purpose-built to drive reliable, efficient operations at all levels. Stratus ensures the continuous availability of production-critical applications by delivering zero-touch Edge Computing platforms.

For more information about Stratus Edge Computing platforms, please contact us here today.

About Stratus

For more than forty years, Stratus has provided highly reliable and redundant computing systems and expert services to complex and constrained operational environments, enabling partners and customers to securely and remotely turn production data into actionable intelligence so they can run operations safely, reliably, and efficiently.

Reference 1: "Smart Manufacturing Challenges Every Industrial Manufacturing CIOs Must Resolve," by Alexander Hoeppe, Sohard Aggarwal, Simon Jacobson, Gartner; 2 September 2022