SMART MANUFACTURING DEPLOYMENT GUIDE

Customer Deployments and Best Practices

TECHNOLOGY THAT MINIMIZES SMART MANUFACTURING DEPLOYMENT COST, COMPLEXITY AND RISK

Smart manufacturing is, put simply, when the data tells us what to do. Industry 4.0 has evolved over the past decade, but a modern smart factory takes a jump forward from legacy industrial automation to a fully connected, optimized, agile, proactive and transparent system that can collect real-time data from every asset, then analyze and learn from the data to optimize processes and adapt to changing market demands.

Most manufacturers today understand the need for smart manufacturing. However, while some factories may be modernizing one aspect of the factory such as monitoring selected assets or using a big data platform, few are taking a comprehensive, enterprise-wide smart manufacturing approach to enable multiple use cases and provide both OT and IT teams with a complete data picture.

In fact, according to McKinsey, two-thirds of industrial companies worldwide say that digitizing is one of their highest priorities. But less than a third of respondents have successfully moved critical use cases beyond a proof of concept into large-scale rollout. Capgemini surveyed 1,000 manufacturers and found that "deployment and integration of digital platforms and technologies" was the number one challenge impeding the progress of smart factory initiatives. Smart manufacturing deployments fail for three primary reasons: cost, complexity and risk.

This guide will explain how manufacturers can overcome the most common deployment challenges to implement a flexible and scalable edge platform for smart manufacturing that provides the critical data connectivity needed to monitor, visualize, analyze and optimize production lines at scale. Key customer deployment use cases demonstrate how to transform a factory into a smart factory by connecting to all data sources on the factory floor to provide a complete data picture across the enterprise to increase visibility, uptime, performance and quality.

DEPLOYMENT CHALLENGES

With the advent of modern technologies there are a long list of ways to attack smart manufacturing, and most companies are testing the waters. McKinsey's survey found that companies are piloting an average of eight different smart factory solutions at once, which may give some insight into why so many projects continue to fail: manufacturers are trying to do too much without the right foundation. IT is built on a flexible and scaleable infrastructure, but what about OT? Why does broad smart manufacturing deployment rollout fail an astonishing two-thirds of the time? Here's an idea.

PILOT PURGATORY

A 2018 McKinsey survey found that 84% of companies deploying an IoT solution are stuck in pilot mode, 28% of them for more than two years. The phenomenon is called "pilot purgatory," when a small-scale test or proof of concept drags on for too long and can slow or even stop smart manufacturing progress. Pilot purgatory happens primarily for one of the following reasons: deployment is slow and expensive, factory systems and data are complex, and the project lacks clear ROI. The good news is after taking a look at the causes of pilot purgatory, there is technology available that can drastically minimize the cost, complexity and risk of smart manufacturing deployments.

84%
of companies working in IoT are stuck in pilot mode, 28% of them for over two years

DEPLOYMENT IS SLOW AND EXPENSIVE

An astonishing number of smart manufacturing pilots last years, which not only slows progress but also increases costs. By the time a project is ready to deploy, business priorities may have evolved, budgets have changed, and new technologies may even be on the horizon. Leaders are often slow to deploy new solutions, holding tight to legacy solutions and failing to see the importance of operating quickly and nimbly to adjust to changing market conditions and increased competition. Many smart manufacturing initiatives also try to do too much at once, adding needless functionalities that escalate costs and complexity.

60%
of time and budget is sucked up by resolving disparate systems on the shop floor

COMPLEX SYSTEMS AND DATA

One of the primary reasons many deployments fail is complex systems and data. The typical factory has multiple disparate systems, hundreds of heterogeneous devices, and is often managed by an OT team with legacy technologies that do not work with IT effectively. Instead of designing an enterprise IT/OT convergence strategy where both teams have a vested interest in the project, local teams often drive siloed approaches without the right expertise to balance edge and cloud computing, and the end result is a deployment that can't scale across the enterprise, or work with big data and cloud applications. Gartner estimates that installed IoT endpoints in the manufacturing and natural resource industries will grow to 1.9 billion units by 2028. Data volumes are only going to grow, and organizations need a way to manage this data explosion.

31%

of Heads of Manufacturing say system integration is the leading challenge in implementing smart manufacturing

LACK OF CLEAR ROI

Many companies fail to clearly define success at the beginning of the project, they simply want to "embrace smart manufacturing." The first misstep is that implementations are often prompted by "shiny" new tech rather than a value-led implementation prompted by a business use case. Success is initially defined as a successful pilot instead of a measurable business goal such as improving OEE, optimizing a specific production line or reducing scrap. Without clear objectives, deployments fail because they never reach an unmeasurable goal. A successful deployment is dependent upon clear metrics from the beginning and designing ways to track the progress of initiatives with both IT and OT involved. Every deployment needs greater accuracy, clarity, and precision when it comes to measuring progress.

61%

of manufacturers see insufficient ROI as a barrier to implementing Digital Manufacturing at scale
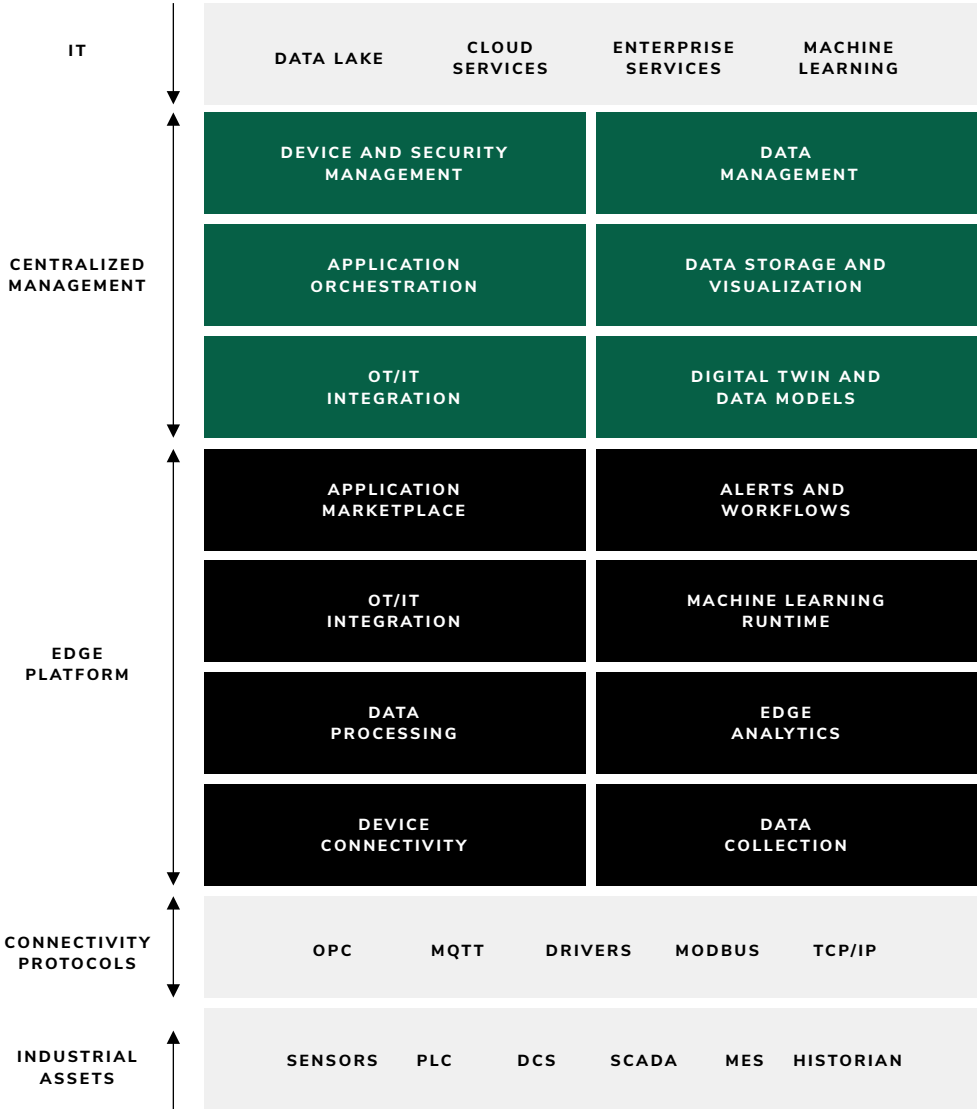
THE MODERN EDGE PLATFORM

Manufacturers need two things to prevent pilot purgatory, speed up deployment time, reduce complexity, and increase ROI. First, an edge platform purpose-built for smart manufacturing with a specific set of capabilities to accelerate time-to-value and reduce cost, complexity and risk. Second, a deployment rollout plan that focuses on defining clear ROI through business use cases, which will be described in detail later.

Successful deployment depends on an all-in-one edge platform with the following capabilities: the ability to connect to any device on the shop floor, manage and normalize the data, integrate with third party enterprise and cloud applications, manage edge device deployments at scale, enable one-click application orchestration and provide data analytics for common manufacturing use cases. When customers deploy a smart manufacturing solution with these capabilities, time-to-value is accelerated and ROI can be realized within days or months, instead of years.

DEVICE CONNECTIVITY
Out-of-the-box support for a wide variety of industrial systems, devices, protocols and controllers.

DATA ANALYTICS
KPIs, visualization, dashboards, video processing, statistical and analytical queries, time series data, machine learning runtime.

DATA MANAGEMENT
Collect, process, normalize and store data at the edge, ready for use by cloud, big data and enterprise systems.

DEVICE MANAGEMENT
Edge device lifecycle management including provisioning, remote configurations, templates and over-the-air-updates.

DATA INTEGRATION
Pre-built OT and IT data integration and support for standard interfaces like Kafka, MQTT, REST API and OPC UA.

APPLICATION ORCHESTRATION
Public or private application marketplace, with the ability to deploy applications and ML models to edge devices.
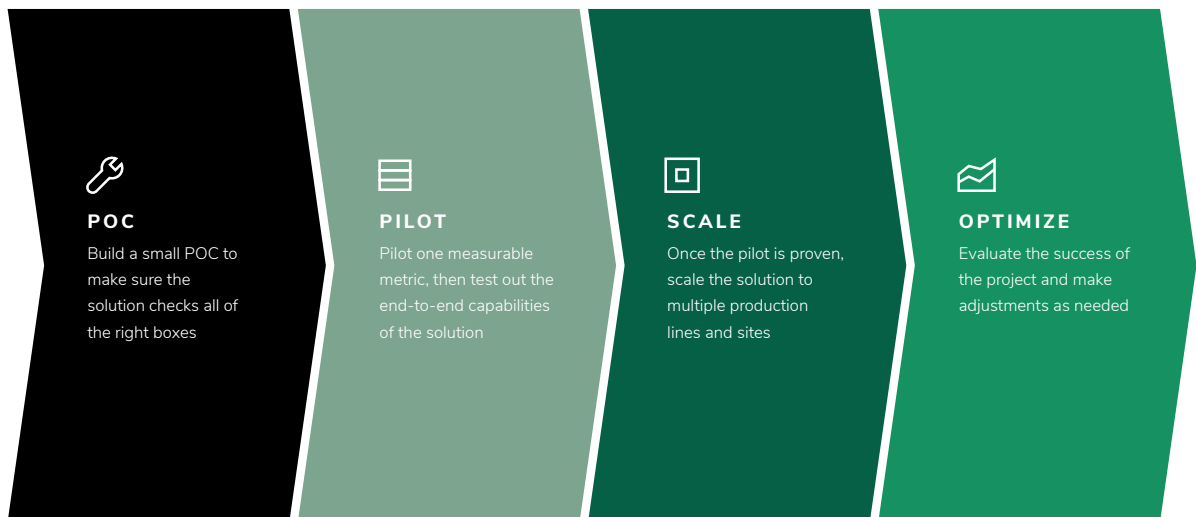
EDGE PLATFORM ARCHITECTURE

An all-in-one edge platform that can handle complex systems and data by connecting to any data source to collect, analyze, manage and integrate industrial asset data sets the right foundation to solve smart manufacturing deployment challenges. The ability to connect to any type of asset with any protocol, then perform edge computing with a centralized management layer with one solution reduces complexity and sets the stage for full scale rollout. This intelligent edge platform provides the common infrastructure to move data up to IT and back to the edge with seamless cooperation. Now everyone in the enterprise can access the same tools, dashboards, data models, and KPIs so everyone is on the same page for smart manufacturing success.

IT	DATA LAKE	CLOUD SERVICES	ENTERPRISE SERVICES	MACHINE LEARNING

CENTRALIZED MANAGEMENT	DEVICE AND SECURITY MANAGEMENT	DATA MANAGEMENT
	APPLICATION ORCHESTRATION	DATA STORAGE AND VISUALIZATION
	OT/IT INTEGRATION	DIGITAL TWIN AND DATA MODELS

EDGE PLATFORM	APPLICATION MARKETPLACE	ALERTS AND WORKFLOWS
	OT/IT INTEGRATION	MACHINE LEARNING RUNTIME
	DATA PROCESSING	EDGE ANALYTICS
	DEVICE CONNECTIVITY	DATA COLLECTION

CONNECTIVITY PROTOCOLS	OPC	MQTT	DRIVERS	MODBUS	TCP/IP

INDUSTRIAL ASSETS	SENSORS	PLC	DCS	SCADA	MES	HISTORIAN

HOW A SUCCESSFUL SMART MANUFACTURING ROLLOUT WORKS

The right edge platform provides the ideal foundation for deployment success. With true flexibility and scalability, manufacturers can develop a proof of concept to make sure the solution checks all of the important boxes, then enter the pilot phase to ensure it satisfies every requirement for deployment. The customer can quickly derive value and show ROI with instant KPIs, dashboards and visualizations while they test the technology. No more two-year pilots stuck in pilot purgatory, this type of pilot will show its value in less than 30 days and then scale to a small deployment followed by multiple production lines and sites. A successful deployment is agile, encouraging continuous evaluation and improvements that allow OT and IT teams to add data points and use cases as needs evolve over time. Include both IT and OT teams in the entire process - too often OT teams choose a solution, and then enterprise-wide rollout fails because IT was never involved in the process. The following steps ensure a successful smart manufacturing deployment.

POC
Build a small POC to make sure the solution checks all of the right boxes

PILOT
Pilot one measurable metric, then test out the end-to-end capabilities of the solution

SCALE
Once the pilot is proven, scale the solution to multiple production lines and sites

OPTIMIZE
Evaluate the success of the project and make adjustments as needed

🔧 PROOF OF CONCEPT

Start with a clear vision of what the smart manufacturing initiative needs to accomplish. Determine the business goal – is it to gain visibility into the shop floor, to power a big data platform with a complete data picture, or perhaps to create dashboards for the maintenance team? Develop a checklist of things the product must be able to do to reach the goal, and look for an all-in-one platform that can collect, analyze, manage and integrate all data from every asset on the factory floor. Develop a proof of concept that starts with the platform on the shop floor to see how it behaves and choose one or two data points to collect that fit into the business goal. At the same time, consider future scaling needs by adopting a platform that will grow with the project rather than forcing you to adopt a myriad of solutions. The point of the proof of concept is to make sure the solution checks all of your important boxes, and to gain enough confidence in the product to know you can implement it and move to the pilot stage.

- ✓ CLEAR VISION OF THE INITIATIVE
- ✓ DETERMINE THE BUSINESS GOAL
- ✓ PRODUCT CAPABILITIES CHECKLIST
- ✓ DEVELOP A PROOF OF CONCEPT
- ✓ MAKE SURE THE SOLUTION DELIVERS AS PROMISED

▤ PILOT

Once a solution is chosen, define a specific use case with clear metrics and goals to measure the success of the pilot. Start by solving one business problem such as reducing downtime or scrap on a specific line. Determine the data points needed to detect anomalies and trends, determine who needs access to the data and where you want the data to go. Implement all aspects of the platform, from data collection, to local analytics, to integration with big data and enterprise applications. A complete OT-IT deployment is critical to understanding the technical requirements needed for success. The pilot is designed to not only help you test capabilities of the platform, but to also give you the opportunity to understand how to integrate new technology into your day-to-day operations. The right technology should uncover new insights and new behaviors.

- ✓ SOLVE ONE CLEAR BUSINESS PROBLEM
- ✓ DEFINE THE DATA STREAM
- ✓ DEPLOY SMALL TO PRESERVE CURRENT PROCESSES
- ✓ DELIVER DATA TO THE RIGHT PEOPLE AT THE RIGHT TIME
- ✓ TEST OUT ALL CAPABILITIES

SCALE

If the pilot shows ROI and the features are fully tested and explored, you can be confident you can apply it across all machines in the plant and are ready to move to the next stage. Scale the solution to multiple production lines, and ultimately multiple plants. Create a template to scale safely and easily with proven best practices. The edge platform can handle any number of devices or sites with centralized edge management tools and application orchestration. The solution grows with the customer so once the initial deployment is proven, more data streams and more use cases can be added safely to increase productivity, efficiency and quality across the business. Analyze larger data sets, create more dashboards, and integrate with big data or machine learning platforms for even more ROI. Continue to evaluate and adjust regularly to get more business value out of the deployment.

✓ **CREATE A TEMPLATE FOR DEPLOYMENT**
✓ **MANAGE EDGE DEVICES CENTRALLY**
✓ **SCALE TO MULTIPLE PRODUCTION LINES**
✓ **SCALE TO MULTIPLE PLANTS**
✓ **EXPAND USE CASES AND DATA POINTS**

OPTIMIZE

In the evaluation phase, OT and IT stakeholders evaluate the success of the project based on the success criteria adopted at the beginning of the deployment and make adjustments as needed. Think about lessons learned, what else can be done and how to build on success. Do you need more data? Should you expand to new use cases? If changes are needed, redefine the scope quickly and deploy again in a matter of days. An agile smart factory that can adjust based on how things are going will pay dividends in the long run. A modern edge platform is flexible enough to make changes on the fly, create new dashboards, add data points, send data to a new application, and more. Taking the time to stop and measure success, then improve upon the process takes discipline but is well worth the effort, especially for a smart manufacturing deployment that thrives on continuous improvements.

✓ **EVALUATE LESSONS LEARNED**
✓ **REDEFINE THE SCOPE AS NEEDED**
✓ **MAKE ADJUSTMENTS TO THE AGILE SMART FACTORY**
✓ **BUILD ON SUCCESS**
✓ **CONTINUALLY IMPROVE THE PROCESS**

FOOD AND BEVERAGE

A bottled water manufacturer operates numerous bottling plants around the world. They sought an industrial IoT platform that could collect and process data at the edge for immediate visualizations and business value, then send the clean and valuable data to the cloud for further processing.

CHALLENGES

- Heterogeneous industrial systems on the shop floor
- Multiple data acquisition systems creating data silos
- No manufacturing analytics
- Lack of insight into data for predictive maintenance
- Lack of shop floor visibility across the enterprise
- Insufficient maintenance practices due to missing data

SOLUTION

The customer implemented the Litmus Edge-to-Azure platform by adding Litmus Edge to the shop floor. Litmus Edge connected to all of their disparate devices, collected, normalized and analyzed the data, and then integrated with Azure IoT Hub for further processing in the cloud. Models are then sent back to Litmus Edge for continuous improvement through the Azure Container or Litmus Edge Manager, a centralized management system for all edge deployments.
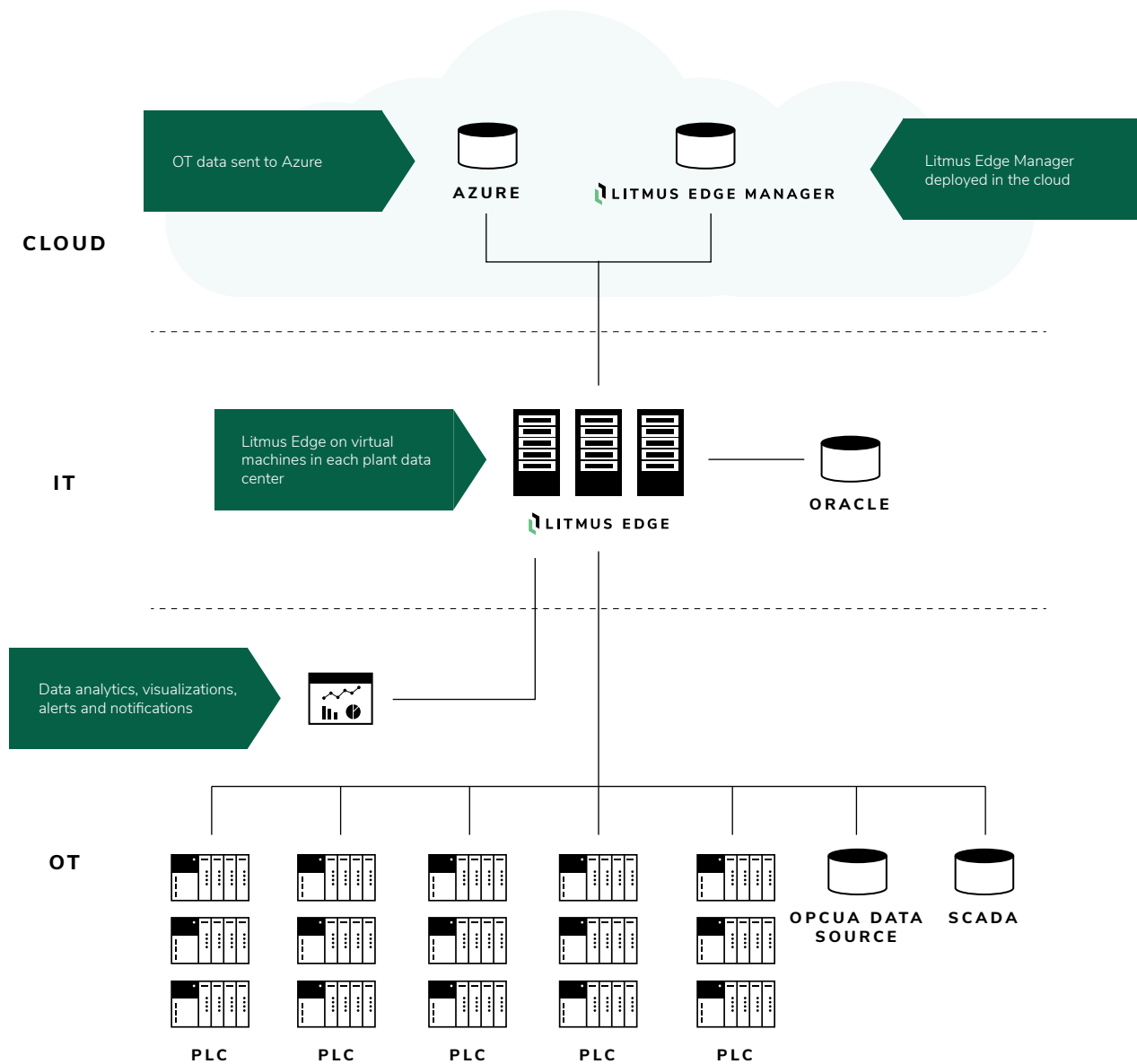
OUTCOMES

- Connected and collected data from a myriad of industrial systems in a matter of days
- Eliminated data silos to easily share data across OT and IT teams
- Enabled anomaly detection to see what is affecting quality
- Integrated the solution into their maintenance system to create automatic work orders
- Reduced downtime and optimized maintenance schedules to save time and money
- Created statistical models to predict machine failures

ARCHITECTURE

- Litmus Edge on virtual machines in each plant data center
- Data sent to Azure Cloud and Oracle Maintenance System
- Litmus Edge Manager deployed in the cloud
- Plant visualizations and local processing on Litmus Edge

CLOUD

OT data sent to Azure

AZURE

LITMUS EDGE MANAGER

Litmus Edge Manager deployed in the cloud

IT

Litmus Edge on virtual machines in each plant data center

LITMUS EDGE

ORACLE

Data analytics, visualizations, alerts and notifications

OT

PLC **PLC** **PLC** **PLC** **PLC**

OPCUA DATA SOURCE

SCADA

A multinational corporation that designs, manufactures and distributes building and high-performance materials set out to achieve a simple and centralized Industry 4.0 strategy – to transform all shop floors into a digital workplace and generalize a data-driven approach for use cases. The end goal was to provide the right data to the right person for the right purpose.

CHALLENGES

- No visibility into assets on the factory floor
- Data trapped in machines, Historian and MES
- Several production lines with a high level of automation
- Machines from a wide variety of vendors including brownfield assets
- Up to 20 different machines on each production line

SOLUTION

The customer chose to install Litmus Edge on the shop floor for its ability to connect to the full breadth of OT and IT assets with out-of-the-box support for any driver, protocol or connection. They started small and then added data points and use cases as the solution showed ROI. The solution could integrate the data to any destination and was easy-to-use with little training required and a reasonable total-cost-of-ownership.
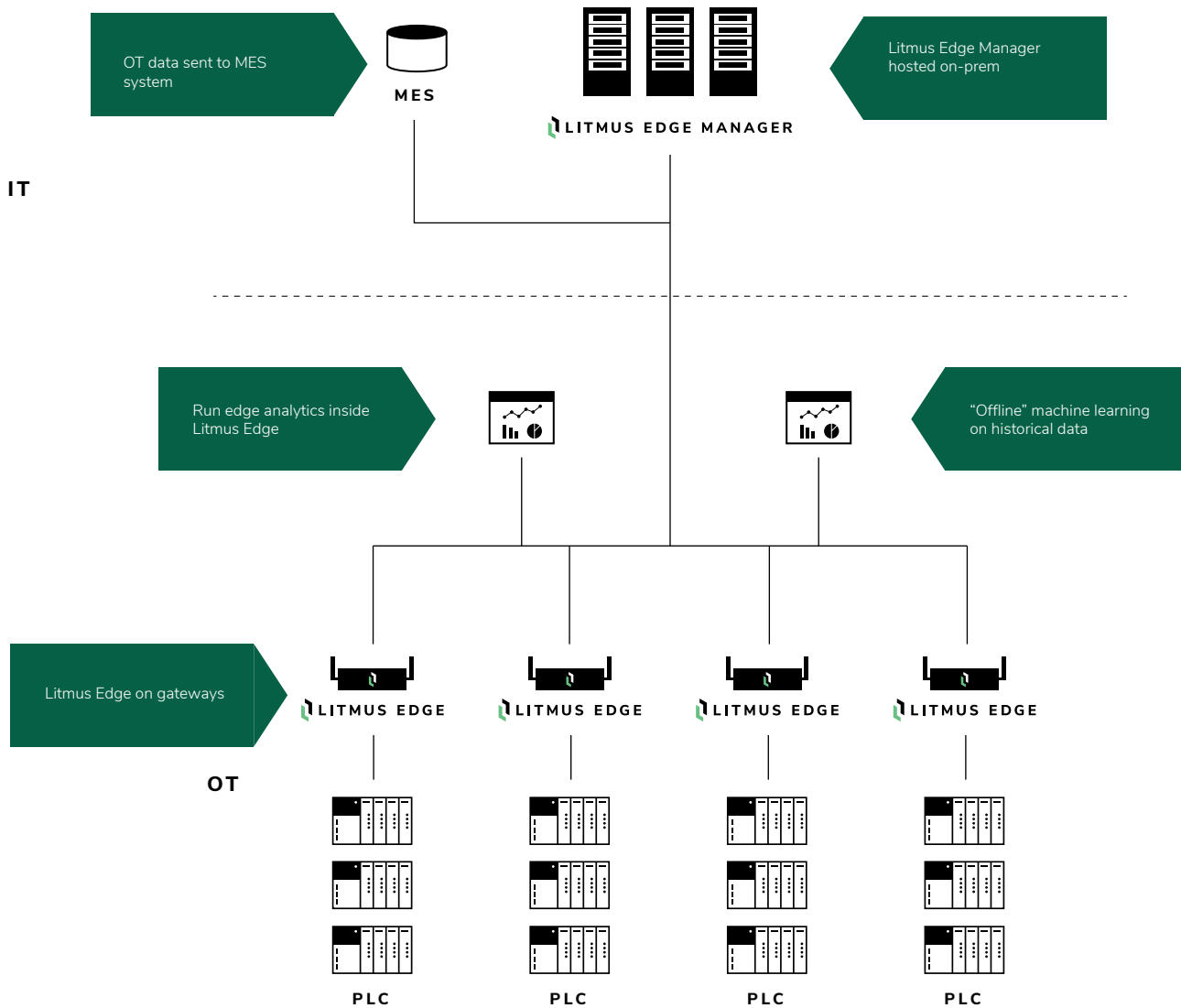
BUSINESS OUTCOMES

- Rapid deployment to 20 plants in the first year
- Collected a multitude of data points that can be accessed by anyone in the plant
- Achieved a consolidated view of all data across all cells
- Improved operations and production
- Derived instant value from live analytics with dashboards, alerts and process improvements
- Performed "offline" machine learning on historical data by collecting, storing, analyzing and building an analytics model
- Enabled edge application deployments and edge analytics with complex dashboards

ARCHITECTURE

- Litmus Edge installed on HPE gateways
- Litmus Edge Manager hosted on-prem to manage devices at each location
- Send data to MES and Historian systems

IT

OT data sent to MES system

MES

LITMUS EDGE MANAGER

Litmus Edge Manager hosted on-prem

Run edge analytics inside Litmus Edge

"Offline" machine learning on historical data

Litmus Edge on gateways

OT

LITMUS EDGE **LITMUS EDGE** **LITMUS EDGE** **LITMUS EDGE**

PLC **PLC** **PLC** **PLC**

A multinational engineering company that designs and manufactures power systems for transportation was primarily looking to gain visibility into OEE parameters on the shop floor. They sought an industrial edge platform that could unlock data in legacy machines along with a secure method to centrally deploy applications to the edge.

CHALLENGES

- Legacy machines with locked data based on OPC-DA
- Security requirements dictating data collection and apps run on the shop floor
- Segregated VLANs requiring physical gateways for data collection
- Mandate for secure central management of applications
- Lack of a method to "push" and manage data models to the edge devices

SOLUTION

The customer implemented physical gateways on the shop floor to provide additional segregation by VLAN. Each gateway runs the Litmus Edge software with Litmus Edge Manager used in a regional data center to provide overall management of the edge devices. The Litmus solution also provides native integration to Siemens MindSphere for future use. The customer developed edge applications centrally and then deployed them to the edge devices on the shop floor with usability for engineers while maintaining structure and security guidelines at the central level.

BUSINESS OUTCOMES

- Connected and collected OEE and downtime data from data-locked legacy systems
- Provided visualizations at the equipment, cell, line and factory level
- Improved the accuracy of downtime reporting to improve maintenance and throughput
- Overall reduction in downtime and scrap
- Ability to collate data centrally into MindSphere
- Ability to develop common applications and deploy them securely to the shop floor

ARCHITECTURE

- Litmus Edge installed on gateways
- Litmus Edge Manager deployed in regional data center for centralized management
- Integration with Siemens MindSphere
- Data models generated in MindSphere and pushed to the edge
- Applications developed centrally and pushed to facilities securely

CLOUD

SIEMENS MINDSPHERE

Integration with Siemens MindSphere

IT

LITMUS EDGE MANAGER

Litmus Edge Manager deployed in regional data center

Data models generated in MindSphere and pushed to the edge

Applications developed centrally and pushed to facilities securely

OT

LITMUS EDGE   LITMUS EDGE   LITMUS EDGE   LITMUS EDGE

Litmus Edge installed on gateways

PLC   PLC   PLC   PLC
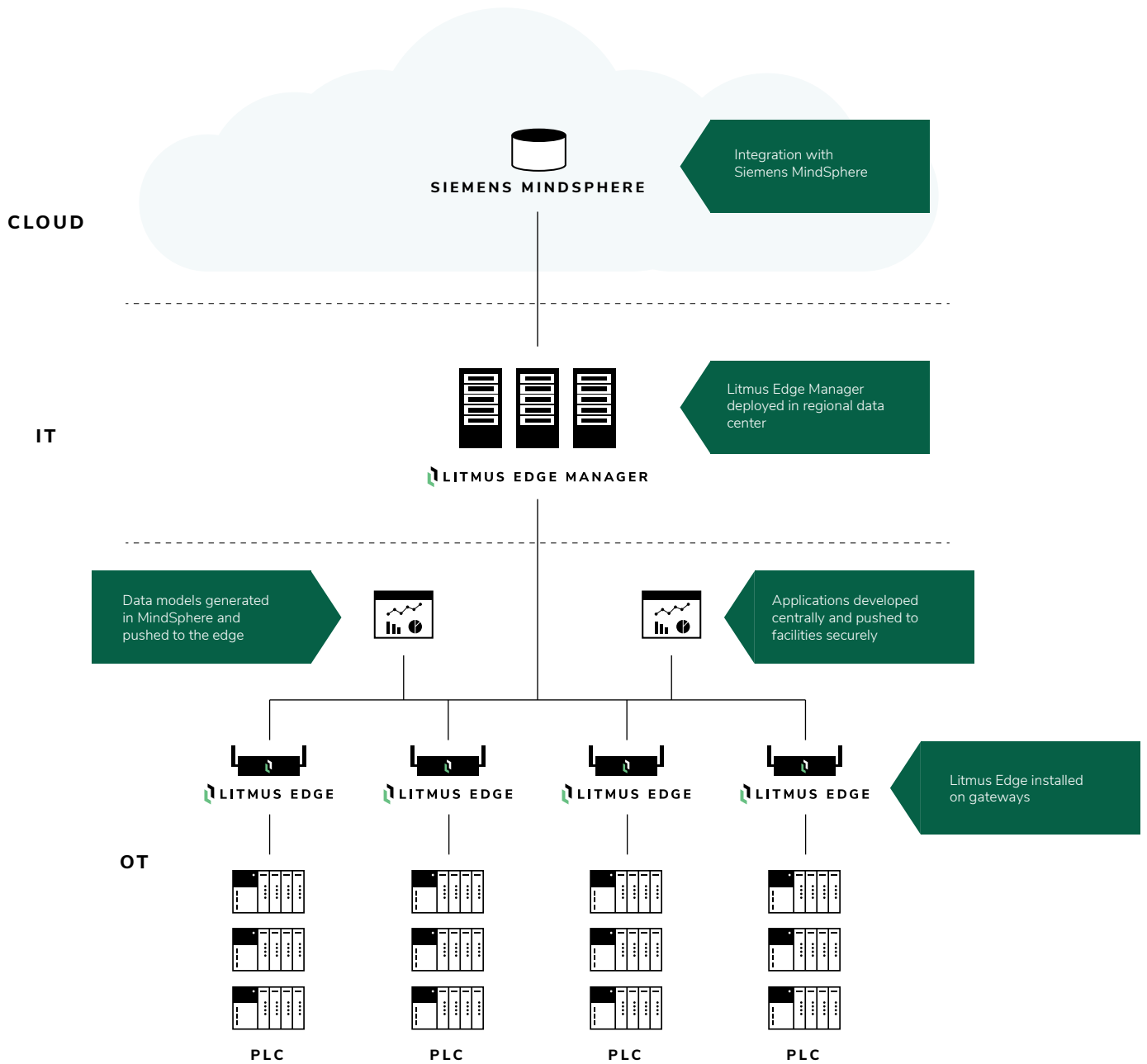
DEPLOYMENT READINESS

Industrial companies who choose the right platform and prepare properly can reduce deployment costs, complexity and risk for a successful pilot and full-scale rollout across multiple sites. Before deployment, ask yourself and the entire smart manufacturing team the following questions and make sure you can answer affirmatively.

- Do you have a dedicated team, mandate and executive support for the initiative?
- Do you have buy-in from both OT and IT teams?
- Have you agreed upon a single business goal and data stream for the pilot?
- Have you agreed upon measurable business goals, objectives and outcomes for the entire initiative?
- Do you have an agile plan that allows for change over time?
- Do you have a way to easily connect a complex mix of modern and legacy OT data sources on the factory floor including PLCs, DCS, SCADA, MES, historian, databases and sensors?
- Do you have IT, cloud or big data systems set up that can receive OT data for advanced analytics and machine learning? If not, do you have a platform that can provide instant edge analytics to make use of data at the source?
- Do you have the in-house expertise necessary for a successful rollout? If not, have you chosen a platform that requires little coding and expertise so it can be implemented successfully?
- Does the entire team understand the value of collecting OT data and using it to understand and optimize operations?
- Do you have a plan for how to easily scale to multiple edge deployments with centralized management and control over all edge devices?
- Do you have a way to deploy purpose-built applications and deployment templates across all sites?
- Do you have a way to run machine learning and analytics models at the edge for continuous improvement?

LITMUS

THE EDGE PLATFORM FOR INDUSTRY 4.0

LITMUS.IO