SMART MANUFACTURING:

Building the **Factory of Tomorrow**

SIEMENS

Table of **Contents**

INTRODUCTION

Industry 4.0 is **entering a new phase**

For the better part of a decade, manufacturers have made significant strides to drive efficiencies, boost agility, and improve product quality by implementing data-capture sensors and analytics systems. Now, they are capitalizing on that foundation to optimize interconnectivity, automation, machine learning, and real-time data to further enhance production outcomes and improve worker safety and well-being.

These outcomes are made possible by incorporating the Industrial Internet of Things (IIoT) with smart manufacturing to link physical production, operational processes, and facility management with digital technologies. The marriage of these traditionally disparate components leverages machine learning and big data to gain real-time insights across processes, products, and people.

To begin the smart factory transformation, manufacturers are changing how they think about their processes. Digitalization can offer data-driven, real-time solutions for challenges within the building envelope, which range from worker comfort to optimizing energy usage.

This paper will explore the smart factory journey and how it intersects the building envelope with IoT solutions. And that means investing in smart infrastructure to gain measurable insights for facility efficiency, sustainability, and staff optimization goals.

Manufacturing Challenges

The digital journey is paved with opportunities and challenges. One of the biggest issues manufacturers encounter is the "hidden factory," the industrial equivalent of "shadow IT." Faced with new pressures, managers and workers develop workarounds that create unknown risks to production and their personal safety.

The pressure to meet production and delivery schedules can trigger unsafe shortcuts, but by using real-time data collection through IOT sensors and meters, operators can get visibility into the operations of the equipment and the building envelope. Operators can then use this data to help ensure safe working environments for employees, perform maintenance based on predictive analytics, and receive key notifications to prevent unplanned downtime. This lowers the overall OPEX and provides higher throughput for the entire factory.

That pressure to meet production demands can increase when considering the building envelope, which often contributes to operational challenges due to inefficient HVAC, energy, and facilities management systems. These challenges translate into production problems such as downtime due to reactive maintenance and network communication issues. The results are lost production and inefficient workforce management. Manufacturers need to set the foundation for smart, data-driven decisions. Those decisions lead to real-time improvements and support long term planning for people, processes and services.

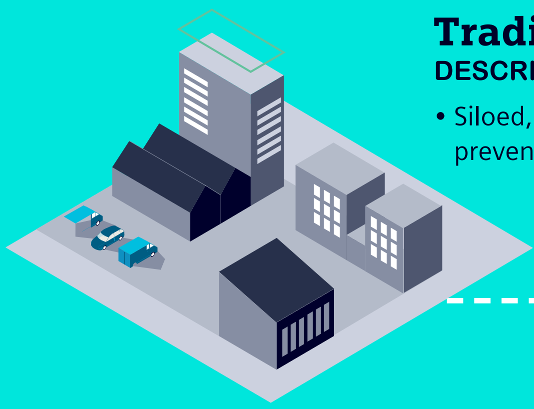
The Smart Factory Journey

The smart factory delivers competitive advantages for manufacturers by enabling improved operational performance and greater throughput.

The ultimate goal is to move toward autonomous operations driven by AI, prescriptive maintenance and digital twins for building management. These solutions lead to a tighter integration between production and IT systems. Achieving prescriptive status means having the ability to capture, share, and act on data to anticipate system issues and thereby achieve higher uptime.

This goal requires vision, planning, and investment. In the traditional model of plant operations, production systems operated in silos with little or no communication between them. Maintenance issues were identified upon equipment failure and once identified, corrected on site. These dated practices lacked the ability to remotely diagnose issues and/or correct the problem. Downtime instances were lengthier and more frequent. The digitalization of a factory means that as factories evolve, they can predict issues that will occur and remedy issues before they would otherwise occur. This is the finish line; the implementation of the prescriptive model that enables autonomous factories.

Journey to **Digitalization**



Traditional Plant
DESCRIPTIVE

- Siloed, on-premise systems, preventative maintenance on site

Integrated Plant
DIAGNOSTIC

- Integrated building management
- Remote diagnostics

Smart Factory
PREDICTIVE

- IoT applications
- Real-time data analytics
- Single pane of glass

Autonomous Factory
PRESCRIPTIVE

- Simulation and AI-based on building digital twin
- Prescriptive maintenance
- Integration of building and mobility

In the autonomous factory, systems work in unison, sharing data for various purposes: corrective action, productivity, and sustainability goals. Rather than keeping costly maintenance crews on site, manufacturers can often handle troubleshooting remotely by leveraging resources such as a digital service center, equipped with machine learning, AI tools, and technical experts that can work with a smaller number of on-site facility technicians. Ongoing data collection and analysis make it possible to schedule planned maintenance around peak production times to avoid interruptions.

Prescriptive factories leverage IoT and edge computing to build a smart infrastructure with centralized management. A single pane of glass with visibility to data from the building envelope provides managers with comprehensive insights about their building in areas such as maintenance programs, energy, and maintenance activity. Inputs available through a single pane of glass include:

- Factory environmental conditions
  - Lighting
  - Fire/employee safety
  - Energy management
  - Building security
- Reliable and uninterrupted factory power supply
- SCADA protection and control
- Backup power generation
- Cloud applications and services
- Status of electric vehicle fleet charging

Smart Factory Outcomes

The smart factory rides on the precept that what gets measured through digitalized processes leads to delivering desired factory outcomes. These outcomes can be broken into two general types: manufacturing and human-centric. Human-centric outcomes protect the health and safety of employees while manufacturing outcomes improve operational processes through efficiency.

Today, factories are capable of manually producing desirable outcomes, but digitalizing these processes provide factory managers with feedback loops that yield a more efficient process. Digitalization is crucial in making informed decisions to ensure the human element and production throughput are prioritized.

Manufacturing Outcomes

Smart factory benefits include uptime improvements, better asset utilization, data-driven factory optimization, and energy efficiency. Efficiencies can be achieved by reducing errors, accelerating changeovers, minimizing downtime, and boosting production quality and throughput. Consider the following examples of manufacturing outcomes that smart factories can help to achieve:

RESILIENCY – When power from the grid is down, the factory floor is interrupted, potentially costing millions of dollars in lost production and restarting costs. To prevent this, factories can implement smart switchgear, battery backup and/or generators to create redundancy in the building power supply. In an outage, automated controls switch to the microgrid to avoid downtime, then back to the main grid when power is restored.

SUSTAINABILITY – In operations with lower nighttime energy consumption, manufacturers can drive sustainability goals by using smart energy systems or microgrid controllers that automatically switch to battery, solar, or wind reserves overnight. Partnered with battery storage, these systems can also provide resiliency backup if the grid is compromised.

CYBERSECURITY – While enhanced connectivity drives profitability, sustainability, and facility performance, it also widens the cyberattack surface to potential hackers. Manufacturers can drive security by applying IT cybersecurity building protocols such as BACnet Secure Connect, an enhanced protocol designed to harden building systems.

Human-centric Outcomes

The smart factory's human-centric benefits include safety risk reduction, staff optimization, and flexibility. Protecting the health and safety of employees is critical and can be achieved by creating comfortable working conditions. This makes for more productive workers who are safer and better attuned to their surroundings.

CONSIDER THESE EXAMPLES:

STAFF UTILIZATION – In a scenario where an energy spike causes an alert, real-time monitoring and alerting trigger immediate action to identify the problem. If, for instance, the problem is a slipping fan belt, an alarm notifies a technician who can quickly fix it without having to spend hours troubleshooting.

WORKER SAFETY – In environments where a ladder might be used, the risk of injury increases. Deployment of strategically placed sensors helps reduce risk by making monthly maintenance unnecessary.

However, worker safety and satisfaction extend beyond risk of injury into overall comfort. Temperature and humidity, for example, affect worker comfort and productivity and can even harm production equipment. If the temperature or humidity climbs too high, it can result in worker discomfort and could hinder production processes where a controlled environment is critical. IoT-enabled automated HVAC systems can optimize temperature and humidity throughout the year based on data collected from sensors on the smart factory floor.

Digital OODA

Smart factories enable continuous improvements as information flows from sensors to analytics systems. Manufacturers can apply the OODA Loops concept in the context of digitalization for ongoing improvements:

- **OBSERVE –** create new visibility
- **ORIENT –** turn information into insight
- **DECIDE –** use data, not intuition
- **ACT –** respond to real-time feedback

The OODA Loop was first developed in the 20th century as a military tool that trained Air Force pilots to make quick decisions by acting based on the limited information they were given. Today, the Digital OODA Loop directly aids in the factory decision-making process; the loop supports smart factory operations by optimizing product, process, equipment, and people. If manufacturers integrate this four-step approach, they can accelerate the decision-making process within a smart factory by more efficiently gathering and interpreting real-time data. By gathering data from all systems into one source and contextualizing the information, the OODA Loop enables better, faster decision making.

Siemens Smart Factory Commitment

Siemens has a long, global history of working with manufacturers to manage and continually improve their operations. Siemens Smart Infrastructure offerings enable the integration of the physical and digital worlds in manufacturing to effectively support people, processes, and technology.

Siemens is committed to helping manufacturers on their journey to the smart factory by navigating its customers through the complexities of choosing and implementing the best management platforms and cybersecurity tools to meet efficiency, safety, resilience, and sustainability goals. Siemens comprehensive suite of services and technologies for the smart factory includes:

NAVIGATOR – a cloud-based platform that sets a foundation for data-driven services. It centralizes disparate datasets related to energy consumption, environmental conditions, and equipment health and longevity to enable decisions for better business outcomes.

DESIGO – a building management platform designed to boost efficiency, resiliency, and safety in manufacturing. It leverages open restful APIs to allow multiple systems and devices to flow through Desigo and give managers a single pane of glass for the factory building envelope. Besides integrating systems and devices, Desigo automates processes, meets specific facility requirements, and enables systems to communicate and interoperate in harmony with centralized management.

SIEMENS XCELERATOR – a comprehensive portfolio of software services integrated with an application development platform. It helps companies digitalize solutions that can be personalized and adapted to fit customer and industry-specific needs.

BUILDING X – a suite of AI-enabled, open-platform applications that lets organizations compare energy consumption, emission data, and water usage trends to identify good practices and optimize operations.

ECODOMUS – a digital twin application that lets customers generate digital replicas of buildings and assets, creating a common data environment that integrates BIM, CMMS, IoT systems, and Building Management Systems (BMS).

BRIGHTLY – A cloud-based software-as-a-service (SaaS) solution for asset and maintenance management. Capabilities include CMMS, EAM, Strategic Asset Management, IoT Remote Monitoring, Sustainability, and Community Engagement.

Siemens Smart infrastructure’s approach not only considers the impact of technology and digitalization on production outcomes, but also for the humans who support it. The idea is to bring people, technology, and services together to forge a successful path into the digital future for the lifetime of the factory.

Conclusion

The smart factory can elevate manufacturing to deliver on not only today's industry pressures, but tomorrow's opportunities. By performing measurements throughout their operations, manufacturers get transparency and can drive decisions that keep moving the business forward. In partnership with Siemens, manufacturers can build a digital foundation that meets their worker safety, energy efficiency, resiliency, and production goals.

Siemens Industry, Inc.
Smart Infrastructure
1000 Deerfield Parkway
Buffalo Grove, IL60089
Tel: (847)215-1000

Order no.: 153-SBT-1506