Accelerating Value Realization in the Smart Factory
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Manufacturers are under increasing pressure to optimize profits and efficiencies while simultaneously reducing costs – a daunting challenge. On top of that, they also face significant demand to accelerate value realization even amongst disruptive challenges:

• Aging infrastructure can create high maintenance costs, lost productivity, and wasted resources.
• Maintaining assets without the necessary data insights is reactive and often results in unplanned downtime.
• Customers expect tailored products that meets their needs – mass customization being the norm.
• Smaller, disruptive organizations are creating a tipping point in the market that is driving entirely new business models.

Overcoming these challenges and remaining competitive in an increasingly connected world is what a Smart Factory enables. A Smart Factory is one where manufacturers are using digital technologies to transform their business operations to improve profitability for the entire organization. The Smart Factory uses a never-ending stream of integrated data gathered from system-wide assets, analyzes that data, automatically optimizes factory operations, and empowers humans to make better decisions faster. It helps organizations learn, adapt, and meet market and customer demands.

Making a factory smart means taking advantage of the industrial Internet of Things (IIoT) – technologies that collect and centralize mass amounts of machine data gathered from industrial environments and create value from that data. Solutions built on IIoT platforms collect, aggregate, analyze, and provide insight to enable you to quickly act on the data to boost operational efficiency and production, improve quality and quicken time to market with real-time performance and production feedback.

This eBook explores using IIoT and cloud technologies to create a Smart Factory for new insights to optimize processes and productivity, sharpen competitive advantage, and respond to market changes that deliver value.
Industry 4.0 makes Smart Factory a reality

Industry 4.0 combines cyber-physical systems, artificial intelligence, machine learning, and IIoT to make digitalization a reality via the Smart Factory. In a Smart Factory, technologies drive operational efficiency by helping factories reduce costly downtime and require fewer raw materials, personnel, and energy. Manufacturers can make more custom products at a lower cost. They can iterate product designs and updates faster to be more productive. Customer satisfaction improves as products are built with fewer defects.

Smart Factories often include digital twins – the modeling of physical assets in a virtual world. A digital twin is a virtual representation of a physical product or process, used to understand and predict the physical counterpart’s performance characteristics. Digital twins are used throughout the product lifecycle to simulate, predict, and optimize the product and production system before investing in physical prototypes and assets.

Using the power of IIoT, it is now possible to take the digital twin concept further than it has previously been able to go. By incorporating multi-physics simulation, data analytics, and machine learning capabilities, digital twins are able to demonstrate the impact of design changes, usage scenarios, environmental conditions, and other endless variables – eliminating the need for physical prototypes, reducing development time, and improving quality of the finalized product or process.

Figure 1: This picture represents a digital twin in a production environment, used for improving product and production.
Many companies are ready to begin transitioning to a Smart Factory approach but aren’t sure how to get started. Manufacturing plants of all sizes can achieve Smart Factory rewards with an IIoT solution and cloud-based IT infrastructure and services. These technologies can help lower the risk and upfront costs of Smart Factory adoption, while accelerating time-to-value.

**Why MindSphere?**

MindSphere® is Siemens’ industrial IoT as a service solution, which enables companies to connect physical, web-based, and enterprise systems in one central repository. By supporting multiple protocols concurrently, MindSphere uniquely simplifies and streamlines the connectivity challenges that most industries face – making it possible for every company to collect and transfer data to the cloud for powerful analysis and visualization, enabling real-time insights. Turning digital data into actionable insights help manufacturers realize unprecedented value across the supply chain.

**Why AWS?**

AWS is the most comprehensive and broadly adopted cloud platform, offering 175+ services, including compute, analytics, IoT, machine learning, and robotics. These services help manufacturers capture, analyze, visualize, and act on plant floor data. AWS customers can focus on optimizing production, creating new smart-product business opportunities, and improving operational efficiencies across the value chain – not on infrastructure.
AWS optimizes Smart Factory operations

MindSphere on AWS leverages AWS technologies and services to help you optimize your Smart Factory operations:

**Improve quality**

Even when manufacturers are collecting data from connected machines, they often face challenges created by disparate data sources, stranded data, and ownership issues. These challenges make it difficult to effectively analyze data and identify insights. The MindSphere Integrated Data Lake, built on AWS, allows managers to pull together and analyze unrelated data, facilitating effective collaboration by developing a single version of the truth. When you add machine learning to the mix, you enhance real-time and predictive analytics capabilities to improve quality further and reduce waste.

**Increase production**

The same capabilities used to improve quality can also increase machinery uptime and, in turn, drive production. When you combine machine data across production lines and even multiple factories into federated, integrated data lakes, then leverage machine learning, you get real-time and predictive analytics on your production equipment. These analytics help inform manufacturers of potential issues in asset health and performance that can lead to downtime. Manufacturers can leverage these insights to implement more optimal maintenance practices.

**Secure global infrastructure**

Organizations leveraging on-premises IT resources may lack the scalability and security to support their Smart Factory implementation. Additionally, provisioning on-premises IT infrastructure to bring your Smart Factory to fruition adds significant cost, time, and complexity to the project. When you choose to operate on AWS, you gain access to a secure global infrastructure that can support IIoT deployments at virtually any scale. Native services and a world-class team of security experts help you protect sensitive data. Further, the members of the AWS Partner Network (APN) have reached the highest security standards and provide extensive knowledge to guide your digital journey.
Smart Factories solve disruptive challenges

MindSphere on AWS provides the technology foundation for your Smart Factory journey. With this foundation, you can solve some of the biggest challenges that manufacturers face, including aging plant assets, lack of digital twin feedback loops, and competitors’ disruptive business models.

Modernize aging factory assets

Problem: Aging plant assets can create several challenges for industrial organizations:

- Frequent breakdowns create expensive repairs and costly downtime
- Disruption from smaller, digitalized organizations diminishes competitive edges
- Decreasing efficiency and inconsistent performance leads to lower production yields

Solution: To keep up in the competitive industrial landscape, manufacturers don’t have to decide to replace assets altogether; they can modernize them to mitigate the impact of aging. By modernizing assets, a factory can predict maintenance and repair parts before they break to eliminate the need for scheduled maintenance. Smart factories extend the life of an asset to deliver value realization with cost savings compared to scheduled repairs, reduction in asset breakdowns, and an increase in production. Many industrial devices and equipment have a lot of life left in them and replacing them may not be necessary. Adding ready-made technology (e.g., attaching sensors to legacy equipment), is often all that is needed to increase factory efficiency. This entails using your existing machines by adding sensors to capture data on key operating conditions – commonly referred to as brown-field enablement. This newly captured data can be analyzed locally on the edge or on the cloud directly using MindSphere or through specialized MindSphere on AWS applications to provide greater transparency and insight into your industrial environments. The MindSphere open architecture works with both Siemens and non-Siemens equipment, so it can fit into your existing environment.

Gain real-time feedback from digital twins

Problem: Inability to receive real-time data regarding the physical performance of your production line and product. This challenge can slow time to market and hurt product quality.

Solution: With real-time feedback loops, manufacturers can use data to adjust production quickly, improve product design, and enhance virtual models. Implementing a Smart Factory enables manufacturers to accelerate value by improving quality and quicken time to market with performance and production feedback for overall profitability improvements. The most innovative companies will not only reduce cycle times but also increase yields and create new business opportunities. They can also dramatically enhance their bottom line by implementing technology to improve their product throughout its entire lifecycle with insights gained using closed-loop digital twins from design through production to performance and back again.

The data collected with the MindSphere on AWS IIoT solution provides detailed insights into production operations, equipment usage, and events. By taking this information and connecting it to high fidelity digital twin models across domains, manufacturers
can create an integrated digital thread that enables them to speed up development, optimize manufacturing processes, and improve products for their next version or iteration with real-time insights. Data related to the production system for building a product is connected by a digital thread, the structure of elements in the planning and manufacturing process that enable a connected flow of data across and throughout the normative lifecycle. The digital thread starts with the product design, continues to the production processes, and ultimately to the performance of the product. By looping back to the product, the closed loop digital twin helps create better products, improve operations, and improve profitability.

**Establish new business models**

**Problem:** The market is forcing new business models of “X as a Service”, and its adoption is creating new market expectations.

**Solution:** IIoT enables manufacturers to develop entirely new business models, opening new sales channels and new sources of revenue, such as maintenance as a service, pay-per-use model, mass customization, and application development.

**Customer driven “X as a Service”**

Generate additional revenue by including IIoT technology in your products to remotely track machine performance, usage, warranty and maintenance. This allows you to offer tailored and targeted customer-driven services every time you sell a machine or part. With service level agreements (SLAs) in place, you can provide customers with guaranteed uptime and productivity – driving customer value.

**Pay-per-use model**

By remotely monitoring your machines, you can tell how often they’re being used. This allows you to lease machines to customers and charge based on activity (pay-per-use) – such as usage hours, holes drilled, tons moved, milling feet, and molding pressed – enabling you to sell an outcome instead of just a machine.

**Mass customization**

End users of machines are under pressure to create unique products in small quantities for customers. Meet your customers’ needs by using smart automation to dynamically configure the attributes and specs of the machines or parts they are producing.

**Low-code/no-code application development**

Developing, deploying, and selling your own unique applications tailored to your products and services provides an additional source of revenue and expands your products’ capabilities. Enable your customers to realize the full potential of IIoT-enabled machines by offering fast, tailored applications that satisfy their specific use cases, business needs, and customer demands. Customers of all technical backgrounds can create new value from these applications with low-code or no-code development tools, such as Siemens’ Mendix™ platform.
Simplify digitalization with MindSphere on AWS

Digitalization is a key requirement for manufacturing to remain competitive in a new digital era. Acting now, at the forefront of Industry 4.0, will yield the biggest competitive advantage. With MindSphere on AWS, the digitalization journey can be accelerated. Connecting assets across the world to one system does not require downtime or piecemealed connectivity solutions. Insights gained from the resulting digitalization help lower costs, improve product quality, drive new efficiencies and performance levels, and shorten response times to customer requests and market demands. Digitalization can also provide the opportunity for new services and business models.

MindSphere connects real things, including physical assets and AWS resources, to the digital world and enables high-value, industry-based applications, and digital services to drive business success. Additionally, its open architecture enables a rich partner ecosystem for industry-specific solutions.

Easy to adopt
MindSphere allows you to pursue IIoT strategies without the time and cost traditionally associated with implementing new technologies into your assets and processes. AWS allows you to easily spin up the IT resources needed to support your IIoT efforts on demand.

Universally transparent
MindSphere is compatible with both Siemens and third-party assets, helping you continually derive new value from your entire device fleet—no matter how diverse it is. With a MindSphere on AWS data lake and aggregation capabilities, you can analyze data across disparate sources to create new value along the entire value chain.

Built with expertise
Siemens and AWS each bring deep experience to digitalization: Siemens with its decades of experience in industrial automation and industry solutions; AWS with its innovative cloud services. This expertise is validated by Forrester naming MindSphere as a leader in Industrial IoT Software Platforms, and Gartner naming AWS as a leader in its Infrastructure as a Service (IaaS) Magic Quadrant for nine consecutive years.
Siemens and AWS together

Siemens Digital Industries Software and AWS are working together to help manufacturers understand how they can speed up innovation and rapidly increase the design process while inspiring new manufacturing techniques. AWS and Siemens collaborate to help customers realize value from a smart factory through fully connected “closed loop” digital twin technology.

Siemens and AWS have been working together since 2012. In 2017, AWS collaborated on the development and delivery of MindSphere v3. MindSphere on AWS delivered the openness and scalability needed for partners to build IIoT applications and was certified by AWS as “Well Architected.” MindSphere customers often build complementary solutions on AWS services to supplement MindSphere, leveraging an ecosystem of partners and developers from Siemens and AWS to create applications.

MindSphere on AWS is based on more than 40 AWS services and makes leveraging services in connected systems easier and more economical. Data Lake expansion and Machine Learning are examples of easier additions through the partnership and often follow initial implementation success.
Get Started Fast

Start fast and lean with MindSphere on AWS.

For more info, please visit siemens.com/mindsphere and mindsphere.io/aws

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