

Are you ready for smart manufacturing?

The benefits of smart manufacturing are significant. Is your organization ready for the investment and the reward?

Executive Summary

Data collection, dashboards, sensors and machine controls have been around for a long time. So does that make smart manufacturing something new or just a repackaging of past practices with new technology? And for companies wanting to gain business value from smart operations, like new income streams, product and solution innovation, and increased asset utilization, where should they start? And how fast will they realize ROI? Improving productivity is a key benefit of the Industrial Internet of Things (IIoT), but is it still the best target? *(Hint: probably.)*

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7 QUESTIONS TO ASK Before You Consume Smart Manufacturing



Introduction

Smart manufacturing offers significant benefits: faster response to changing market and consumer demands, reduced inventory, and improved efficiency and productivity, just to name a few.

In smart manufacturing discussions across the enterprise, from shop floor to top floor, people are making assumptions (sometimes inaccurate) about what it is, who is ready to consume it and how (and how soon) they will benefit. As someone who makes decisions every day about manufacturing technology, I know first hand how beneficial the right discussions can be – and how distracting bad assumptions can become.

1 *Are your smart manufacturing assumptions accurate?*

Depending where you're located in the world, you might reference smart manufacturing, Industrie 4.0, Made in China 2025 or Advanced Manufacturing Partnership 2.0. All are based on the same premise – investing in programs and initiatives to help accelerate and recognize the new era of IT-optimized manufacturing that can be a catalyst in the next big industrial movement. What we're seeing now, and will only continue to see at an accelerated pace, are paradigm shifts in quality, productivity and global competitiveness.

For this whitepaper, I assert that smart manufacturing also assumes:

- We operate under an umbrella called the Industrial Internet of Things (IIoT).
- Connected, smart devices in the IIoT drive greater productivity and efficiency – greater than we've ever seen before greater than we even know is possible now.
- Better data consumed intelligently drives smarter, real-time decision-making.

Before we dig deeper into the other questions I'll answer in this whitepaper, let's talk about ***two of the biggest misconceptions around smart manufacturing.***

- 1. With smart manufacturing, you need fewer people.** You might be using smart devices, and you might be connected end to end, but you still need people to engage technology. Smart manufacturing without people is like a smartphone without a user. For anything real or useful to occur, a symbiotic relationship is required. Smart manufacturing augments people; people drive productivity.
- 2. One size fits all.** You do not buy smart manufacturing the way someone buys a product off the shelf. Solutions are tailored, and they address a specific industry, company and challenge, even down to discrete versus process or high-mix-low-volume versus high-volume-low-mix. While your desired outcome might be the same as the manufacturer down the street, how you deploy smart manufacturing strategies to get there will be as unique as your operations.

Universally, smart manufacturing is sustainable, optimized and demand-driven. It's how we'll do more without adding cost to the equation. That's because people and machines will collect, consume and use data wisely to make better real-time decisions and will collaborate to become more efficient and productive.

The result: Driving the desired output to meet changing consumer demands and the ability to take advantage of emerging technology opportunities.

One accurate assumption is that smart manufacturing can create an environment that's more sustainable and optimized for real-time production that allows a quicker response to changing conditions. And that means you can:

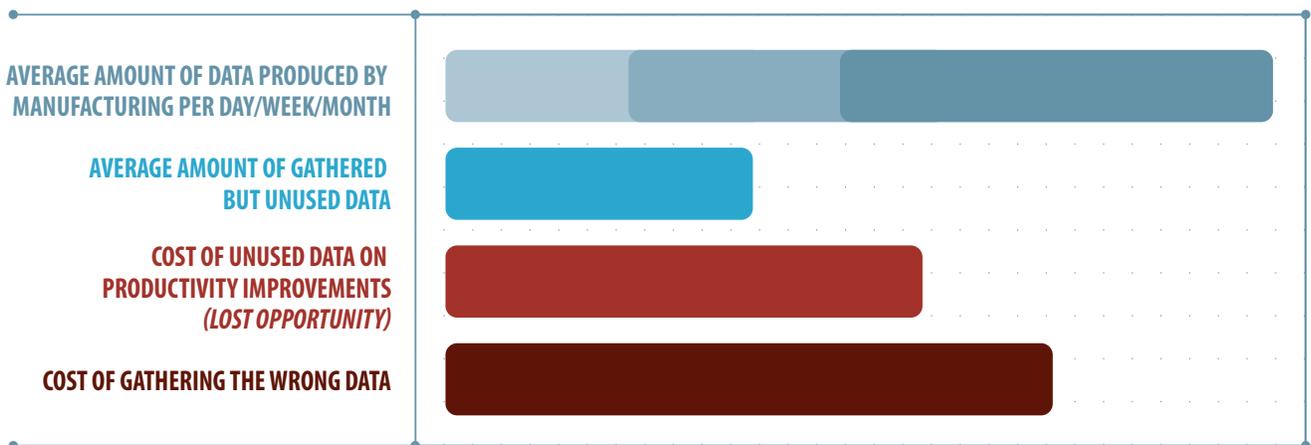
- Respond to customers faster – moving from forecast-driven to demand-driven operations
- Minimize supply chain risk and variability
- Reduce inventory
- Increase production efficiency, through things like faster changeover times (self-adapting machines), error-proofing processes and real-time quality analysis

Smart manufacturing is how we'll do more without adding cost to the equation

2 Why the sudden (intense) focus on smart manufacturing?

We've always had data – from machines, processes and operations. In fact, if you have any smart machines in your operation right now, you may be data rich. But do you have the right data to understand where you are, how you got there, where you should be and what you need to do to get there?

As producers, we struggle with articulating data to save time, to prevent errors and to turn data into insights. The ability to leverage insights to increase capacity, reduce cost and improve quality is hampered when IT departments manage OT-related analytics tools.



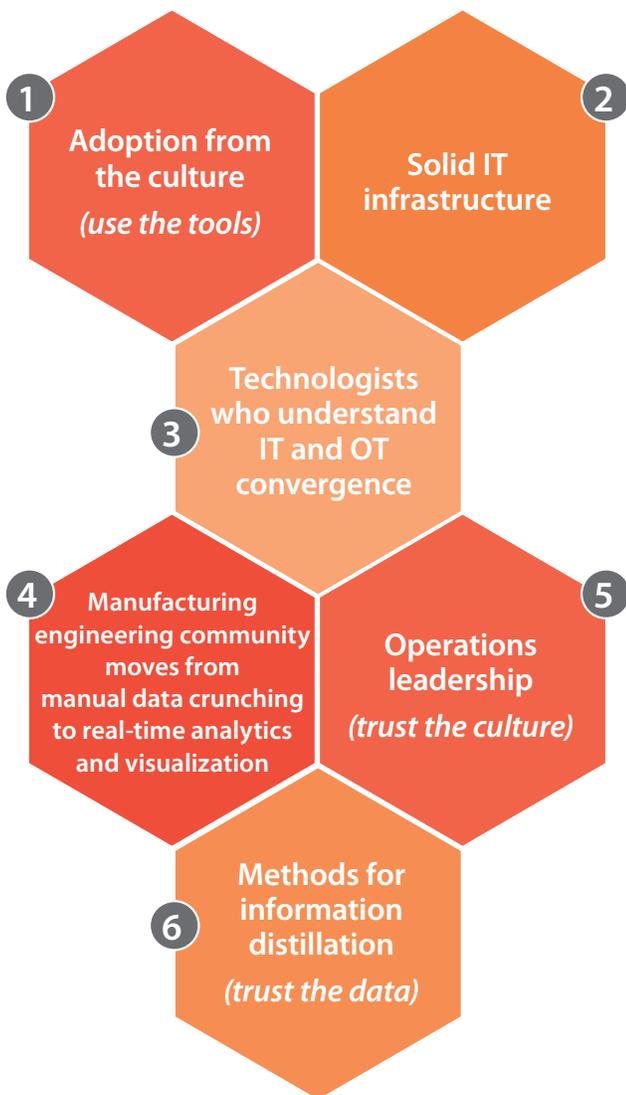
One solution is to employ a data scientist to mesh your data so you can understand, optimize and improve your manufacturing practices.

If that's not a realistic option (and let's face it, for most operations, a dedicated data scientist is not in the plan), you can create a robust analytics environment to visualize and then optimize that data so operators (remote or on-site) can act on what they see (and become their own data scientists).

The availability of analytics, and the ability to create the robust analytics environment to harness and use that data, is the driver behind the intense focus on smart manufacturing.

Six things you need for a robust analytics environment

A healthy, fruitful and sustainable analytics environment doesn't just happen. It requires:



Any company with a manufacturing execution system (MES) is amassing data. The existence of systems to capture that data is not the issue; the challenge is the maturity of these six core requirements and getting them to coalesce on one path forward.

User experience matters

How that coalescence happens is most obvious in the user experience. It's also one of the biggest motivators of smart manufacturing.

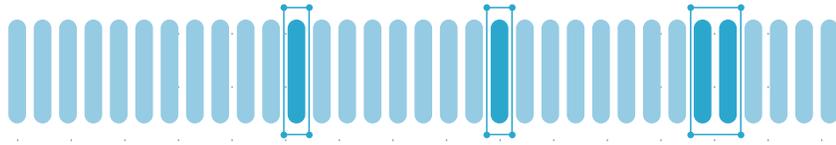
The apps on your devices are intuitive, quick to read and easy to understand. How do I know that? If an app is not instinctive and discerning, I would not use it – and you would not either.

One element of smart manufacturing that has driven its appeal is the user experience. Progress means we leave behind archaic practices like number crunching on a spreadsheet. Now, software packages not only create your desired analytic, but they create a dashboard so accurate and so real time that you know exactly when something has gone wrong (or is about to go wrong), so you can act without taking days or hours to interpret data.

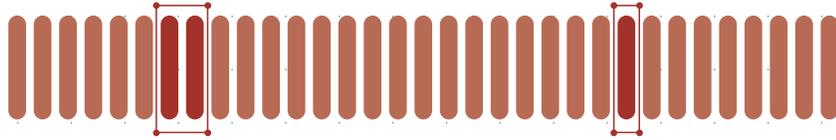
I liken this to how we used a pencil to balance a checkbook – now this happens online. Same math, same bottom line, but now we can see the information anytime, anywhere, and trend it to see how we're spending.

PARSE DATA AT EVERY LEVEL

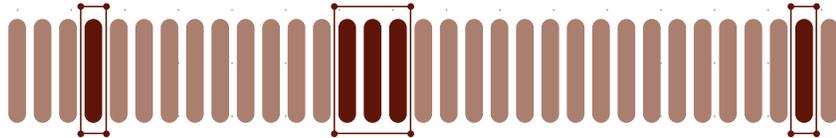
MACHINE DATA



MANUFACTURING PROCESS DATA



ENTERPRISE DATA



When you can parse data at every level – from machine to manufacturing process to enterprise – you can become surgical in your movements and go directly to fixing a problem that before this level of specificity, you didn't even realize you had.

3 *Is smart manufacturing a thing or a system of things?*

Smart manufacturing is a manufacturing system that gives you information as you engage it. It's inclusive of every stage, from product design and supply chain to manufacturing and customer delivery. It all starts with an order and our desire to be more efficient and engaged in the process of delivering that order, from concept to commercialization to customer.

Having connected machines will allow you to better leverage the most powerful element that too few organizations today are fully capitalizing on: your own real-time data.

This intangible commodity is the key to better understanding your operational performance at the most granular level so you can improve operations, and produce more at higher-quality levels, in a more efficient manner.

But to capture this value, you must adopt these enabling technologies:

- **Smart Things** – more devices connecting to your networks
- **Data Analytics** – turning data into actionable information
- **Scalable Computing/Cloud** – leveraging scalable computing, including off-premise resources
- **Mobility** – immediate awareness of the data, leading to a more productive workforce
- **Security** – everything must be secure

THE CONNECTED ENTERPRISE

OPTIMIZED FOR RAPID VALUE CREATION



Another intangible commodity of smart devices is engagement. Through feedback and machine learning, the diagnostics in our ecosystem – our system of things – can learn behavior to expect what's next, what's right and what's wrong and to fix itself.

In manufacturing, it's all about time and touches. Your labor costs are time to build a finished good from components. Through feedback, the more we know, the easier it is to eliminate time and touch and to reduce the opportunity for error.

Through smart devices and smart manufacturing, we can track and trace every single component of every single product that's part of every single solution and system. And you can validate it based on your smart manufacturing process giving you feedback.

PRODUCTIVITY INCREASES WHEN...





Smart devices advance our ability to do things efficiently and safely



4 Do smart devices and big data make manufacturing smart?

No, they do not. Smart devices, collaborative robots and big data are not **creating** smart manufacturing; **they are enabling it.**

A system where all things are connected, a truly connected enterprise, will drive:

1. Improved product productivity
2. Improved system efficiency
3. More accurate scheduling
4. Better enterprise risk management

Real Results

Here's an example. Like many industrial and manufacturing companies, Rockwell Automation has a diverse product portfolio. We have plants spread across the globe and across a variety of manufacturing processes, averaging 200 different part numbers per order and a product life of 20 years.

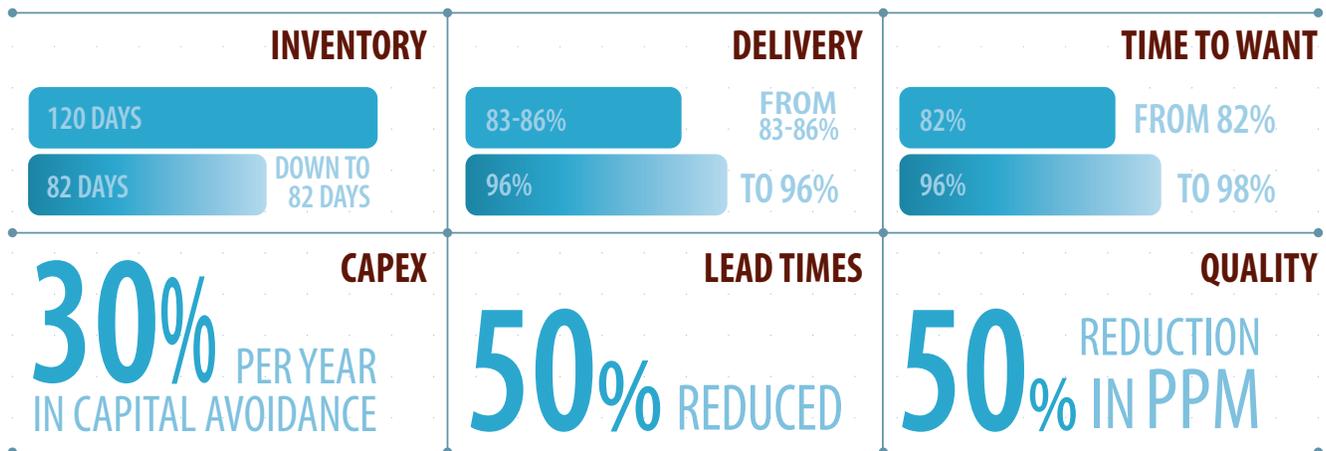
In addition to standard or make-to-stock manufacturing, some sites are geared toward engineer-to-order (ETO) manufacturing, and others produce custom-made products and parts. Others are configure-to-order (CTO) manufacturing plants that configure all variable parameters associated with a base product chosen by an OEM or end user.

We made a goal to gain a new view of our enterprise that allowed plant managers and operators to read actionable information quickly. By integrating applications into one system, overall production functionality improved and supported our transition toward standardization.

By integrating information across IT and control systems, and from the plant floor to the enterprise, we optimized our communication capabilities and business agility by creating our own Connected Enterprise and achieved some incredible results.

Smart devices do not make manufacturing smart; they work in concert with users of the information to make it smart.

THE CONNECTED ENTERPRISE ROCKWELL AUTOMATION TRANSFORMATION



PRODUCTIVITY INCREASE 4% TO 5% PER YEAR

Smart devices advance our ability to do things efficiently and safely. They provide data; the cloud is the repository of that data, when necessary. (In many cases, it's more efficient to keep the data at the machine rather than the cloud.)

The point is, we can pull from all of these places to mash up the data and use analytics to create the exact dashboard we need to make real-time decisions.

5 What does smart manufacturing produce (that's useful to you)?

Smart manufacturing systems deliver productivity and efficiency – and they do so within the confines of specific schedules. You produce what the customer expects, within budget and on time.

So smart manufacturing is a system of discrete, connected devices that produce the information that allows people to make the right decisions to drive the desired manufacturing outcomes and reach targeted improvements.

Supported by Software

Any smart manufacturing system must include software packages that support:

- **Visualization.** This includes MES layer integration, machine data visualization, and business unit alignment.
- **Optimization.** Focuses on operational efficiency and productivity, application of analytics, and risk management.
- **User Experience.** Takes into account the abilities of any user, scalability from plant manager through operator, and operational intelligence.

How many times have you walked into your manufacturing area to find operators guessing about an issue? Software leverages data and visualization to remove assumptions and improves efficiency by offering the correct diagnosis of a problem. Operators can fix that problem rather than relying on guesswork and hit-and-miss tactics that potentially create new problems.

Software like FactoryTalk InnovationSuite, powered by PTC, provides greater productivity through simplification of complex processes.

This is an example of a software suite we use that helps us optimize our industrial operations and enhance productivity – it provides decision-makers with improved data and insights, offering complete visibility of operations and systems status from one source of information inside the organization.

McKinsey & Company
 did a survey and found that only **1%** of the data from 30,000 sensors on a typical oil rig is used for process improvements. Most of it is used for diagnostics and alarming. You've been using Ethernet down at the machine level for years, *but what are you doing with that data today?*

JOURNEY TO A CONNECTED ENTERPRISE

PEOPLE, PROCESSES AND TECHNOLOGIES

CONNECT

Connect plant equipment and people

Use available, standard technologies

Must be scalable and flexible

Do it securely

COLLECT

Leverage information from across the plant and enterprise

Collect data from assets, and organize to improve business processes

EVALUATE

Ensure the assets are able to provide the information needed

Evaluate what data is needed, from which assets, and define how it helps

PRESENT

Contextualize it against other data

Make it actionable, and use it to make smarter decisions

Put it in terminology that's right for the user

OPTIMIZE

Optimize correlation and qualitative analysis of the information for process improvement

Maximize plant workflow in a coordinated way

Make the plant integral to B2B partners

6 What's my investment? And what do I gain?

Your investment in smart manufacturing will vary greatly depending on your current situation.

You need four things before you can start to realize the greatest benefits:

Once these four elements are in place, you can:

- 1. Connect.** This is more than just connecting devices to a network; this is about planning to connect your plants, people, equipment and even your supply chain to gain the real value. And of course this needs to be done securely; you want to take advantage of available and standard technologies to help ensure proper connectivity and security, and you want to plan for flexibility in your architectures so you can evolve over time.
- 2. Evaluate.** Carefully evaluate what data/device/asset you need to connect to and what value you are going to get by connecting it. Make sure that you are getting the data/information out of that asset that can clearly help you improve your processes.
- 3. Collect.** Now that you've decided what to connect, you need to collect that data and organize it to improve your business processes and then leverage this data across your business enterprise. When you can start looking at how operations are running in different locations/sites as an example, you then will be able to collaborate, benchmark processes against each other and share best practices.
- 4. Present.** Presenting the data in an actionable and contextualized format is key. This is where you need to think about analyzing data against other data. Much of the data will be used by many different people in your organization to make better and faster decisions, but they have different ways and views of how that data will help improve their jobs and decision-making. What's important to an operator will differ from a plant manager, although the source of the data is the same asset. Put this in the terminology that's useful for a role to make it more relevant.

1. Culture.

Does your environment right now have a brick wall between IT and OT? Conflicting goals of IT and operations, the reality of needing to extend the life of existing automation assets and myriad confusing technology trends can make it difficult to know if your workforce is ready.

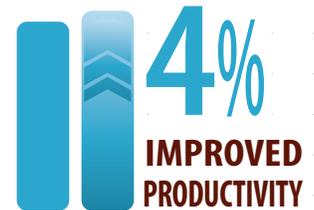
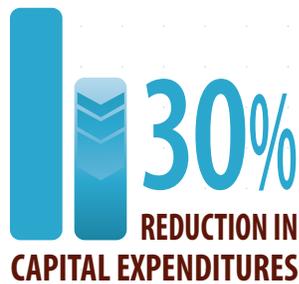
2. Plan. A phased, holistic approach that can leverage your existing machine assets and also allows you to easily integrate promising new technologies is a solid place to start.

3. People. It's important to structure the right cross-functional team that can conduct a comparison of current state versus future state vision to quantify gaps and opportunities. That team needs support from operations and executive leadership.

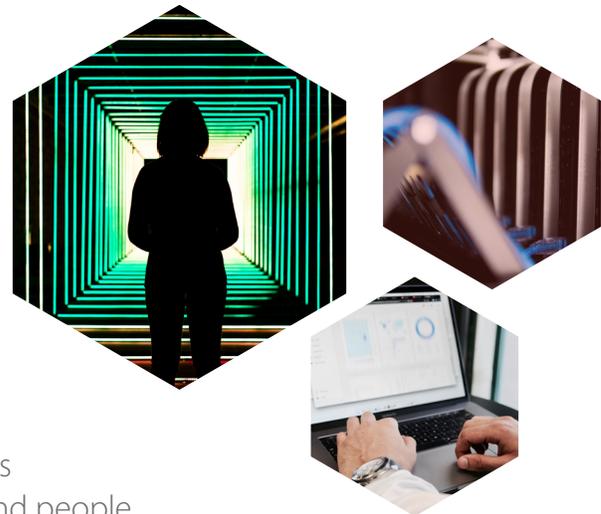
4. Infrastructure. You need a solid, defined architecture to clarify how you can connect at every stage of your value chain and determine where you get the most value. Without this, you can throw the best technology at a problem, but you won't realize your desired outcome, and you'll experience lower-than-average adoption rates because companies won't see the value.

BETTER DATA / BETTER PRODUCTIVITY

THE CONNECTED ENTERPRISE HELPS ORGANIZATIONS BECOME MORE PRODUCTIVE



5. Optimize. Everyone involved in smart manufacturing has something to gain. This is where real values start to unfold. You've structured and contextualized the data, and now you can start to do correlation, quantitative and qualitative analyses of the information to start to drive business improvements. You'll be better positioned to maximize your workflow across operations, and you're creating an environment that fosters collaboration with not only your plants, sites and people, but the entire supply chain.



Smart manufacturing that connects, evaluates, collects, presents and optimizes can help you advance your use of manufacturing and industrial operations to navigate the IIoT and take advantage of real-time information that drives profitability, and that safely and securely boosts productivity.

Your **customers** get the product/system/solution they were promised, when it was promised.

Your **employees** are more engaged, better trained and more capable of handling future OT/IT configurations and advanced technologies.

Your **partners** better understand what is needed and how to deliver, just in time, with better line of sight that makes your manufacturing more predictable.

Your **shareholders** get a better return on their investments because you are driving improved levels of productivity and efficiency – encouraging greater levels of reinvestment. The **world** benefits as you continue to use fewer resources and use them more efficiently.

7 How do I know I'm ready to consume smart manufacturing?

Are you capable, right now, of benefiting from what smart manufacturing can provide?

The information available in manufacturing is not a new phenomenon. In many cases, it's always been there, tucked deep into systems. The differentiator of smart manufacturing is the ease and speed with which this data is available and the mechanisms to make it manageable, usable and, therefore, valuable.

An industrial asset is smart when it gives feedback to the system and is connected to a network. A smart asset needs to be self-aware, system-aware, accessible and visualized.

Your assets will be transformed into intelligent assets that are capable of reporting information, such as energy and diagnostics. Such contextualized data is needed for transformation into actionable information.

- It connects operations with their supply chain and gives better insight into their customers.
- It connects employees to one another for easy collaboration and problem-solving.
- It also connects the business – from operations to enterprise.

You are ready to consume smart manufacturing when you are capable of these three markers:



VISIBILITY

See deeper into operations and logistics, with new ways to link processes and facilities to suppliers and customers.

COLLABORATION

Between people, between teams and departments, and even between the machines themselves.



EFFICIENCY

Transform information into insight, increase ROI, get to market faster, and dramatically reduce waste.

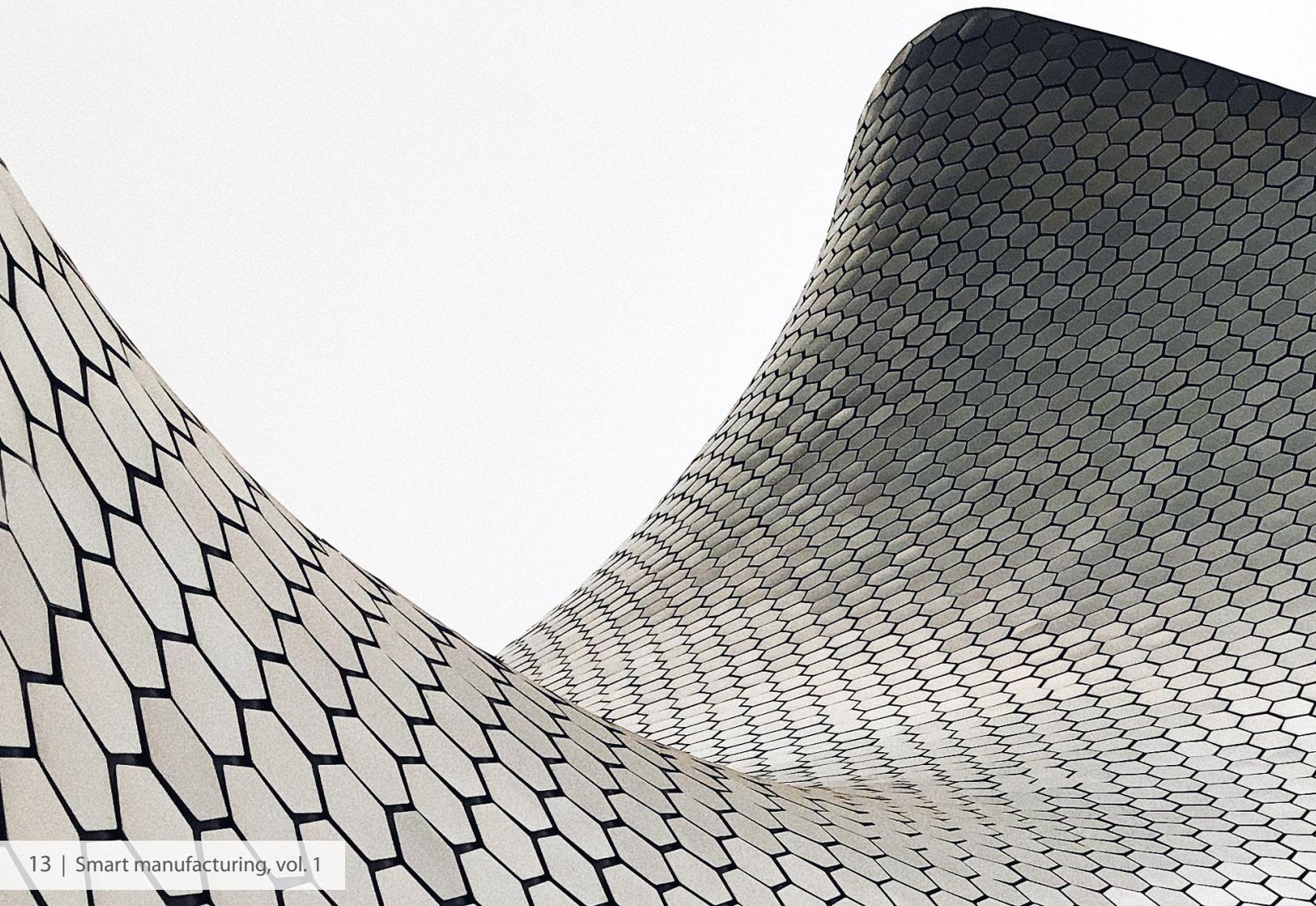
Self-aware assets acquire and process data to report information, such as self-diagnostics and energy use. System-aware assets share common system features; auto-configure key system attributes, such as safety and security; and collaborate with common software tools and interfaces.

Self-aware and system-aware smart assets, when enhanced with contemporary technologies, such as scalable computing, analytics and mobility, create the foundation for your high-performance architecture.

Conclusion

While each of the technologies addressed in this whitepaper can add value to industrial processes, the transformational value of smart manufacturing is only realized when you can seamlessly integrate these technologies in an aware system that is intuitive, self-adaptive and secure.

Are you ready for the IIoT?





This whitepaper is the first in a series created to help manufacturing executives and decision-makers refine their smart manufacturing strategies and focus on key areas that can help drive a more successful IIoT implementation.

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