



# SMART MANUFACTURING: 7 ESSENTIAL BUILDING BLOCKS



SMART MANUFACTURING  
INDUSTRY REPORT  
Vol 1 No 2.

## Advancing Smart Manufacturing

The top two challenges for manufacturers implementing Smart Manufacturing solutions are finding skilled people and figuring out where to begin, according to SME's Manufacturing in the New Industry 4.0 Era Survey.<sup>1</sup>

Here, we'll focus on how to get started defining strategies and implementing solutions by identifying **7 essential critical technology elements** (CTE) building blocks. The important topic of finding and training skilled workers is the subject of SME's third and final Smart Manufacturing Report coming later this year.

### TOP CHALLENGES TO IMPLEMENTING SMART MANUFACTURING SOLUTIONS



<sup>1</sup> "Manufacturing in the New Industry 4.0 Era Survey," SME, March 2018

# Smart Manufacturing

43%

SAY THE  
MANUFACTURING  
INDUSTRY IS ALREADY  
SEEING SIGNIFICANT  
CHANGES DUE TO  
DIGITAL TECHNOLOGY  
SOLUTIONS

## Smart Home to Smart Factory

When it comes to digital transformation, think of it as scaling up from a Smart Home where homeowners are using smart devices for legacy home standalone systems such as HVAC, lighting, security, entertainment or appliances.

Technologies enabling Smart Homes — sensors and cloud-based systems — are bringing the age of Alexa, Amazon Echo's popular intelligent personal assistant, to manufacturing. (See Smart Manufacturing Report #1: A Competitive Necessity)

Actionable data is changing the game. Sensors, enabled by the Industrial Internet of Things (IIoT), collect information, and cloud-hosted software analyzes it, providing operations managers with information to make better decisions, leading to improved productivity, lower costs and increased profitability.



## WHAT MAKES A BUILDING SMART?

### Intelligent Automation System Functionality to:

- Monitor Performance and Detect Inefficiencies Real-Time
- Diagnose Anomalies and Make Automatic Adjustments
- Alert Facility Staff of Issues Requiring Corrective Actions
- Suggest Procedures and Tools for Staff to Fix Operational Issues

### Integrated System-of-Systems Infrastructure that is:

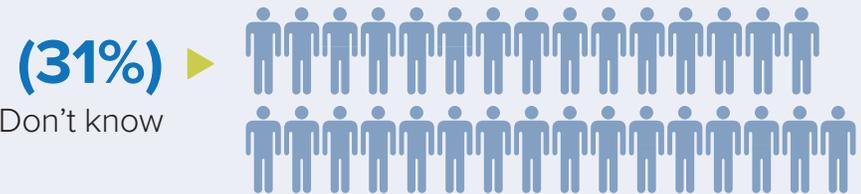
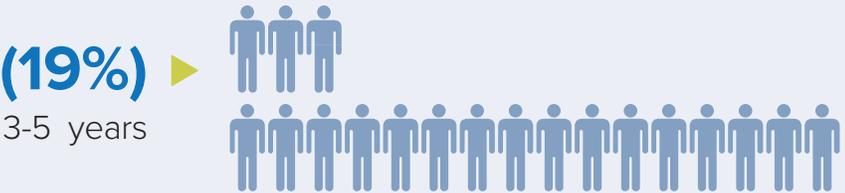
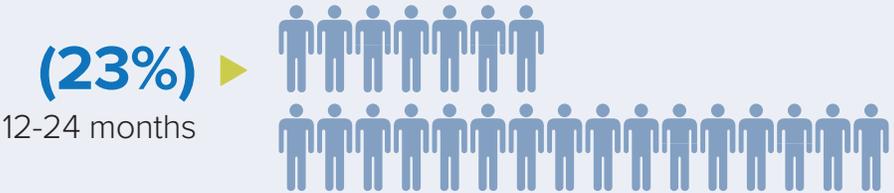
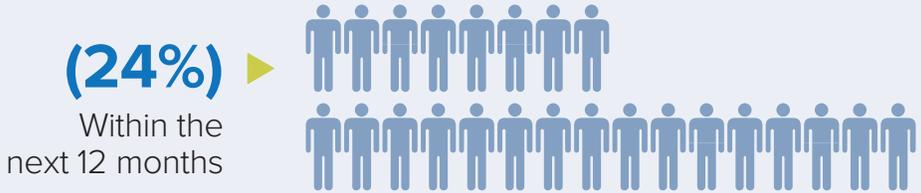
- Highly Automated and Adaptive
- Extensively Networked
- Heavily Instrumented
- Software Intensive
- Safe and Secure
- Increasingly Cyber-Centric

— Al Sanders, PhD, president and owner, Design-Vantage Technologies LLC

# BY THE NUMBERS:

SME's Manufacturing in the New Industry 4.0 Era Survey provides insights on how manufacturers are addressing Smart Manufacturing.

## TIMING FOR INVESTING IN DIGITAL TECHNOLOGY SOLUTIONS



Say Corporate Management should lead the effort for the successful adoption of Smart Manufacturing



Are targeting manufacturing process improvement for Smart Manufacturing

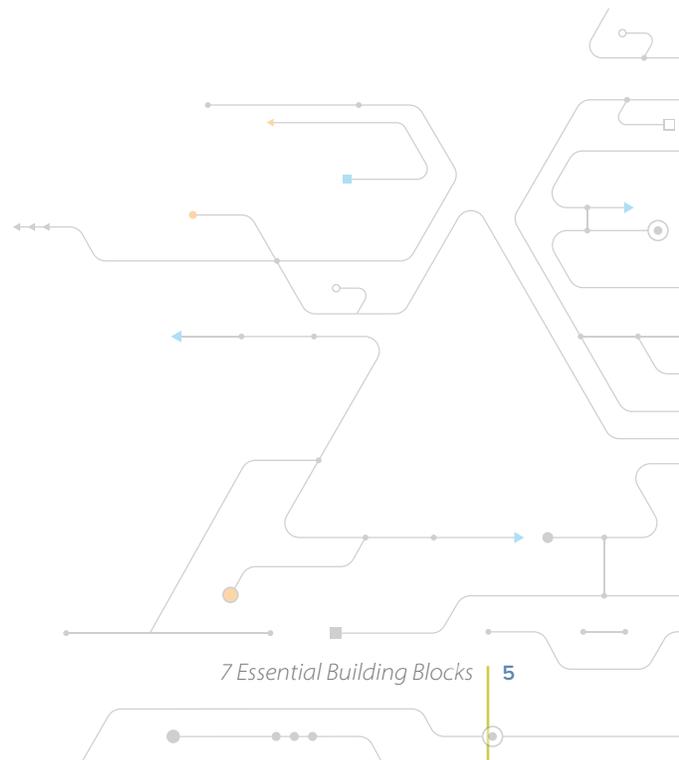
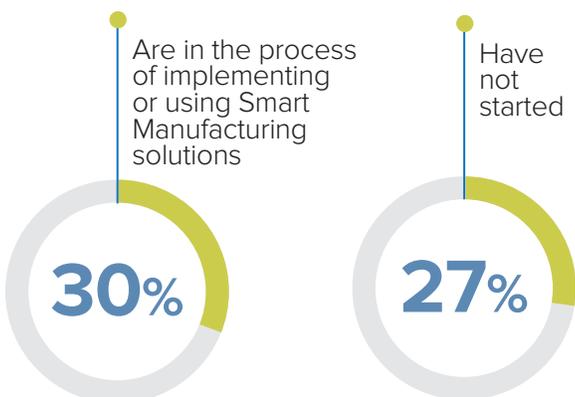
## MOST POWERFUL BENEFITS OF SMART MANUFACTURING



## TOP 5 BARRIERS PREVENTING/SLOWING SMART TECHNOLOGY

1. Cost
2. Lack of knowledge understanding of solutions needed
3. Uncertainty of benefits
4. Lack of skill set to manage implementation
5. Lack of corporate leadership to lead and plan a Smart Manufacturing strategy

## RESPONDENTS USING SMART MANUFACTURING SOLUTIONS





## The Roadmap

A simple, holistic, systems-based framework can help manufacturers create their own roadmaps for the smart journey and to invest in the right technologies and solutions.

It starts with the integration of business and manufacturing systems. This is often referred to as Information Technology (IT)/ Operational Technology (OT) integration, according to Al Sanders, PhD, president and owner of Design-Vantage Technologies LLC. SME partnered with Sanders to create a framework based on 7 smart CTE building blocks (see pages 8 - 9).

“One of the misbeliefs people have is that you’d have to shut down your factories, gut everything and put all new equipment in,” said Sanders. “To the contrary, smart solutions are customizable to fit your existing workspace and you can enhance productivity by integrating a robust new IIoT infrastructure with existing operational OT solutions.”

## Moving Forward Start with a Strategy

# 1/2

Of the respondents indicate that they are eager to learn more about digital technology

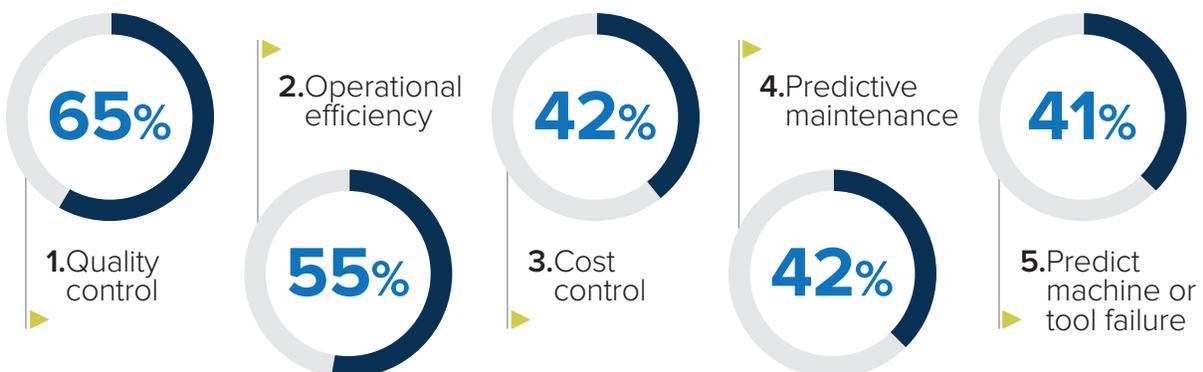
Over half of the respondents in the SME survey indicate that they are eager to learn more about digital technology, but two in five indicate that senior management needs to lead the effort and facilitate and empower the change.

“Developing a strategy for what sort of information you want and where you are today versus where you need to be for the long term is important,” said Rachel Lecrone, Director, Manufacturing IT Systems and Industrial Controls, Cummins Inc. “Whether you are a big organization or small organization, if you don’t have some idea about the road you are on and where you are going and where your competitors are going, you are going to end up with a lot of false starts.”

Data is at the core of the new technology, which includes assisted devices for automation, robotics, 3D printing, cobots, augmented reality, and more.

“It’s what you do with the information once you collect it that’s important,” said Lecrone. “Is it information you want to act on within the four walls of your plant or is it information that you need to compare across plants or across processes or is it that your supply chain needs information that it doesn’t have readily available today? You need to look at where the big problems are and determine how information and data can help you solve those problems.”

## TOP 5 SPECIFIC FEATURES OF DIGITAL TECHNOLOGY MOST ATTRACTIVE TO YOUR COMPANY



# Smart CTE Building Blocks

Manufacturers looking to move to a Smart Manufacturing enterprise must ensure that these 7 CTE building blocks are integrated, based on company business goals.



## 1. Smart Devices:

Smart devices add a layer of intelligent functionality around existing industrial control system activities and automation solutions that currently require manual (human) intervention. Functionality includes the ability to perform necessary communication, computation, and control functions by networking with other smart devices, smart hubs/gateways, and edge computing platforms to transform legacy capital equipment into smart machinery, work cells, production lines, plants/factories, and enterprises.

## 2. Smart Interfaces:

Tablets, phablets, and smartphones are some of the devices allowing human-machine interfaces to improve operations and maintenance activities. These devices facilitate mobile remote monitoring and control of other networked smart devices and smart machinery, the use of mixed reality technologies for the automated delivery of digital work instructions and diagnostics information, and more. Both wired and wireless technologies enable device-to-device, device-to-equipment, and equipment-to-equipment connectivity via smart hubs/gateways to establish new IT/OT interfaces between the two systems via the IIoT infrastructure.



## 3. Edge Computing Devices:



These devices, such as sensors, produce and collect data at the “edge” of the network. The important differentiation is that, through these devices, data is aggregated and analyzed close to the source instead of in the cloud. The devices provide edge intelligence and control at each hierarchical manufacturing system level, interface with the edge networks immediately above and below them, and provide interfaces with centralized IT data management system and OT industrial control system software. This data is actionable right at the site of the machine location, helping increase productivity, reduce unplanned downtime, improve quality, and more.

## 4. Software Platforms & Apps :

All of this technology is made possible through software platforms and apps providing intelligent functionality at each hierarchical edge boundary within the manufacturing system. This includes software platforms and apps that are bundled with commercial-off-the-shelf smart devices and smart interfaces; offered by machine tool vendors as part of OT solutions; and provided by independent software vendors as part of IT solutions. These third-party software platforms and apps can be customized and provide Smart Manufacturing solution retrofit intelligent functionality.



## 5. Data Management Systems:

The collection and analysis of accessible, relevant and secure data helps manufacturers boost efficiency and reduce costs. The challenge is that today's smart systems collect a huge amount of data. Data Management Systems provide intelligent filters and protocols that only share data that falls within predefined parameters to the functions that need it across the enterprise.



## 6. Big Data Analytics:

Big data analytics provide advanced analytical techniques such as statistics, machine learning, artificial intelligence, condition based maintenance, prognostics and health management to uncover and learn from hidden patterns in very large diverse data sets using information that was previously inaccessible or unusable.

## 7. Safety & Security:

The function of the safety and security CTE is to proactively protect manufacturing systems against operator safety issues due to human-machine interactions and cybersecurity vulnerabilities associated with integrating IT and OT systems. Safety and security is an emerging area where additional research and development is needed, allowing the IIoT infrastructure to be reconfigured and additional layers of protection implemented over the system lifecycle.



## What does Smart Manufacturing mean for Talent?

To grow and innovate, it is important that manufacturers train and develop team members on the integration and use of technology. Proactive, aware and engaged U.S. manufacturers are turning to competency models— structured systems for developing the needed knowledge, skills and abilities for specific jobs— to build high-performance teams. One example is the Tooling U-SME Competency Framework for Manufacturing Excellence. This framework features a comprehensive series of competency models in nine manufacturing functional areas. Manufacturers are investing in training programs and using competency models to build the capabilities they will require to remain competitive.

## It's Not Too Late

The good news for manufacturers is that there is still time to jump into this digital technology revolution.

While half of respondents (49%) in the SME survey believe the manufacturing industry will see significant changes over the next 12 months, less than one-third of respondents (30%) are in the process of implementing or using Smart Manufacturing solutions, and another 26 percent have not started investigating the technology.

# 1/3

OF THE RESPONDENTS  
ARE IN THE PROCESS OF  
IMPLEMENTING OR USING  
SMART MANUFACTURING

## TOP 3 GOALS THAT WOULD DRIVE COMPANY TO INVEST IN NEW MANUFACTURING TECHNOLOGY



▶ **75%**

Increase speed of  
manufacturing/production



▶ **61%**

Ensure product/  
service quality



▶ **45%**

Provide more  
value to customers

## Proving ROI

While the technology is still early stage, examples of success indicate there is great potential for Smart Manufacturing to help manufacturers achieve the improvements they need, based on the 7 CTE building blocks.

“It’s important not to lose the benefits beyond cost reduction,” said Jonathan Van Wyck, Partner & Managing Director, Boston Consulting Group. He described a project for an automotive OEM where a 300-point car inspection was reduced to two hours from two days by implementing an augmented reality solution.

“That level step change in performance is what’s possible when you start with a pain point and apply advanced technologies to make it easier,” he said.

Van Wyck added that customers are seeing benefits related to productivity, quality, flexibility and speed. “We’ve seen raw material savings of 2 to 5 percent through reduction of scrap and rework. We’re also seeing improvements in flexibility and speed, for example, we have seen 20 to 60 percent reductions in change over time by applying advanced technologies.”

These successes, like the one from ITAMCO (see sidebar), are helping spur investment in new smart technology. Using the 7 CTE building blocks, manufacturers can enjoy business benefits of their own by joining the digital transformation to improve productivity, performance and profitability.

# Case Study:

## ITAMCO

ITAMCO, an innovative Indiana-based gear shop, started its Smart Manufacturing journey in 2008.

Back then, ITAMCO had purchased a second facility and needed to make sure the systems were connecting in real time. “We were running some different processes but some jobs would run between the two facilities,” said Joel Neidig, Engineer & Lead IT Developer, ITAMCO.

ITAMCO was introduced to MTConnect, a free open standard for the factory which offered an open door protocol for communication. That was the answer.

ITAMCO started building their network so that it was universal, helping them be more planned and less reactive in their processes.

*“First we had to collect the data to start being able to measure what’s going on so it’s not just by hearsay,” Neidig said, adding that there are companies that will analyze your data and tell you where your bottlenecks are for an affordable price.*

*“We are really trying to be data-driven in understanding why we are doing something,” said Neidig, such as invest in a new piece of equipment. If, through data, they see that the existing equipment isn’t fully utilized, it saves this capital expense.*

Data also helps them schedule better. Previously, because they have a large 400,000 square-foot facility, parts would often end up sitting between processes because forklift drivers were in other parts of the facility and didn’t know to pick up the part.

**SOLUTION:** Their forklifts are connected to IoT so when the machine finishes the part, the forklift operator gets notified on a smart device the part is ready for pickup. This resulted in a 10 percent reduction in time between operations.

**“We were doing IoT before IoT was IoT.”**

— Joel Neidig, Engineer & Lead IT Developer, ITAMCO

## About SME

SME connects all those who are passionate about making things that improve our world. For 85 years, SME has dedicated itself to ensuring the health and competitiveness of the manufacturing industry through developing the workforce and promoting advanced technologies.

As a nonprofit organization, SME has served practitioners, companies, educators, government and communities across the manufacturing spectrum. Through its strategic areas of events, media, membership, training and development, and the SME Education Foundation, SME is uniquely dedicated to the advancement of manufacturing by addressing both knowledge and skills needed for the industry.

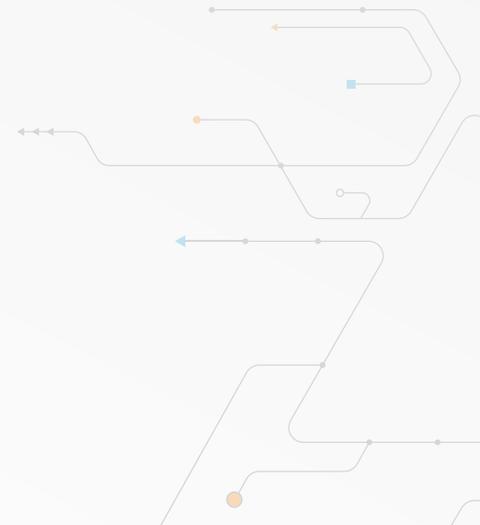
Learn more at [sme.org](http://sme.org), follow @SME\_MFG on Twitter or [facebook.com/SMEmfg](https://facebook.com/SMEmfg).

## About Smart Manufacturing

SME is the hub for Smart Manufacturing knowledge and connections. We are helping companies navigate the 4th industrial revolution via Smart Manufacturing magazine and seminar series, industry studies and white papers, technical groups and the inaugural Smart Manufacturing Experience event. SME connects manufacturers to the latest in smart technologies and expertise every day. Learn more at [sme.org/smartMFG](http://sme.org/smartMFG)

## PROVEN STRATEGIES AND SUCCESS STORIES IN UPCOMING SMART MANUFACTURING REPORTS.

The Smart Manufacturing Report Series by SME helps manufacturers consider, evaluate and execute strategies to become strong entities as the industry shifts to integrated and flexible advanced manufacturing technology and tools. Upcoming reports provide a roadmap for manufacturers who want to adopt these practices, outlining the right technologies and solutions as well as how to recruit and train a “smart” workforce.



## CONTACT

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