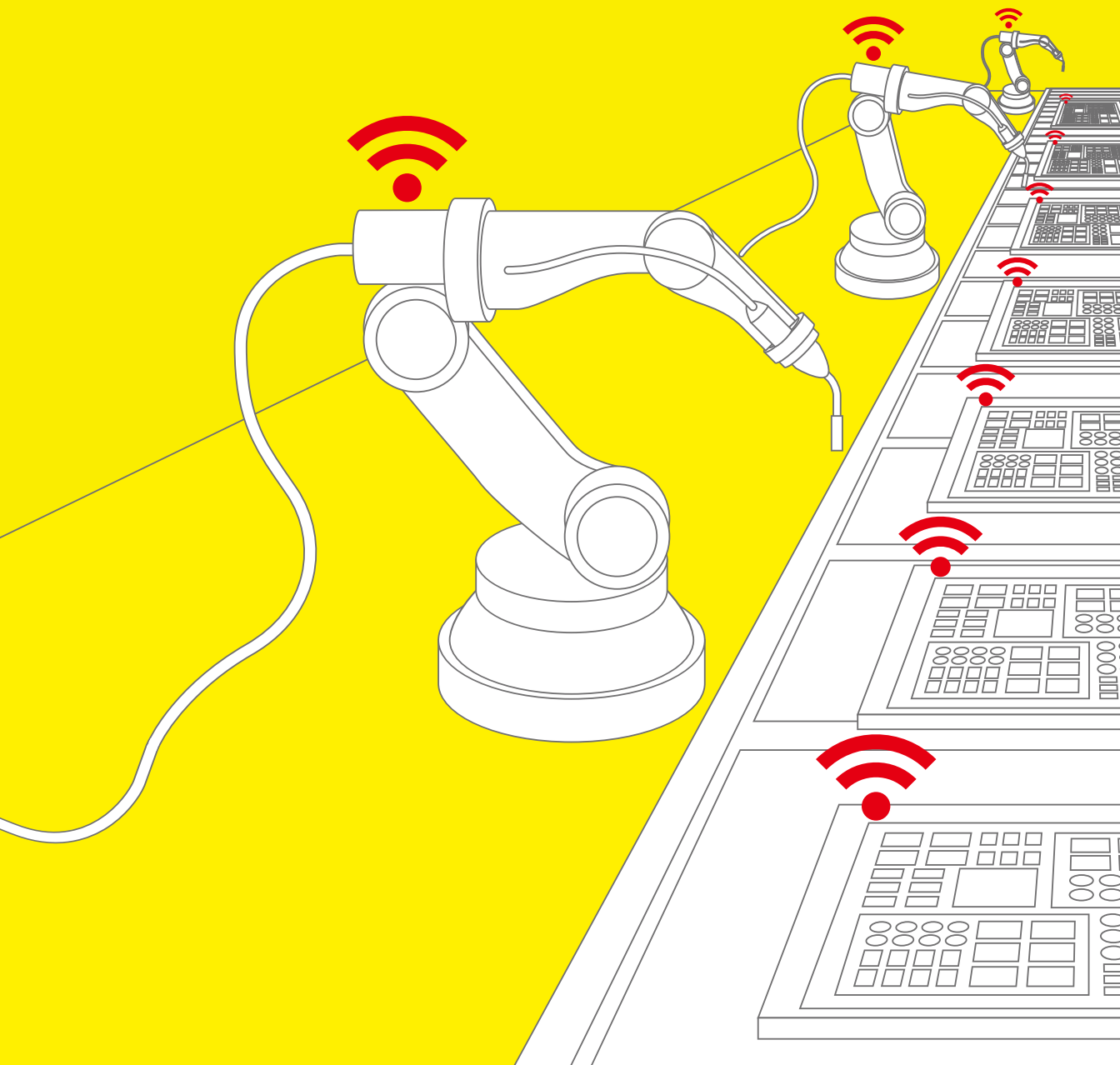


THE INEVITABILITY OF **SMART** MANUFACTURING

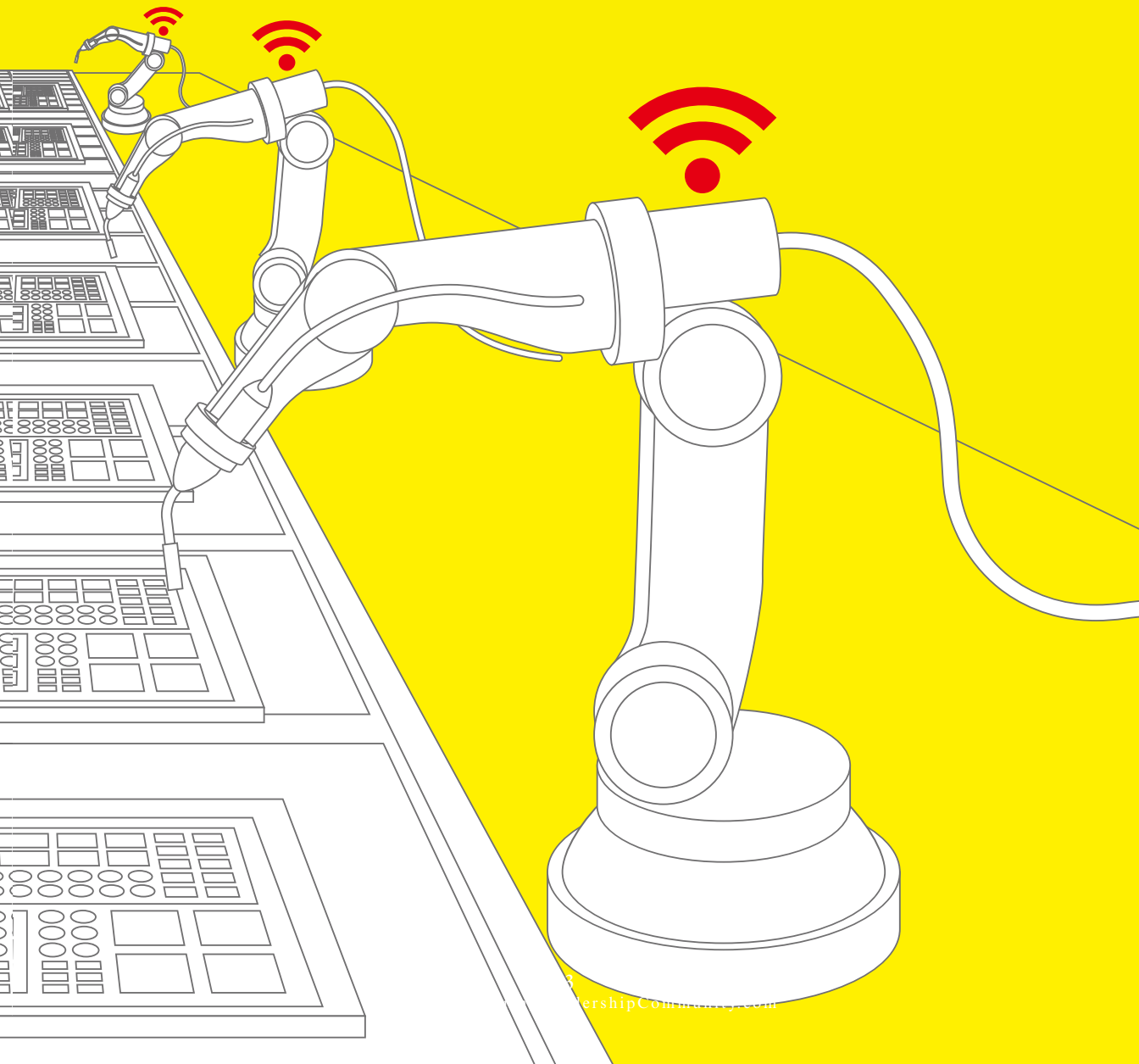




*The Manufacturing Enterprise Systems Association has devised a **five-layer roadmap to enable manufacturers to adopt smart manufacturing technologies, processes, and practices.** Now, manufacturers need to put the digital pieces in place to get there.*



By Tom Hennessey



PETER DRUCKER, WHOSE WORK HELPED ESTABLISH THE philosophical and practical foundations for the modern business enterprise, once elaborated on his definition of innovation:

"Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or a different service. It is capable of being presented as a discipline, capable of being learned, capable of being practiced. Entrepreneurs need to search purposefully for the sources of innovation, the changes and their symptoms that indicate opportunities for successful innovation. And they need to know and to apply the principles of successful innovation."

Substitute "manufacturers" for "entrepreneurs" in that statement, and you'll have a reasonable assessment of what leaders of manufacturing concerns need to be focused on in today's global and rapidly morphing marketplace.

Innovation is not only a tool; it's also a transformational force. In fact, the pace of innovation, driven by astonishing technological development, is transforming manufacturing in what has been called the start of the Fourth Industrial Revolution. In Europe, specifically Germany, the efforts to manage and further that transformation is known as Industry 4.0; in the United States, the similar effort is called smart manufacturing. Whatever you call it, it's the inevitable outcome of a data-driven world where ubiquitous connectivity is breaking down barriers, and the traditional ideas of what a product or company is are fast becoming history. While we haven't accomplished the goals of this revolution yet, the gaps slowing

their realization are being bridged as manufacturers plan for this future

Demystifying Smart Manufacturing

What is smart manufacturing? Consider telephones as a point of reference. Traditional manufacturing is like an old office desk phone, while smart manufacturing is like the iPhone in your pocket. The former was rather limited in its capabilities, while the latter is smart, aware, connected, and provides guidance via multiple downloadable apps. Most of us can't imagine functioning without it. A similar kind of technology transition is taking place on the manufacturing floor.

A number of technological paradigms have converged as enablers for smart manufacturing. These include the mobile internet, automation of workflow, the industrial Internet of things (IIoT), cloud-computing technology, advanced robotics,



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Leiva. “Manufacturers will meet those demands and also provide new services as part of the product, including maintenance or upgrades. You see this in aerospace, where engine manufacturers aren’t selling the engine per se but rather the usage and performance of the engine.”

The old model of manufacturing — produce and deliver the product along with a manual, and you’re done — is obsolete. Increasingly, digital product data is delivered with the physical product, and that data starts in the supply chain. Today, between 50 and 75 percent of a product is made outside the four walls of the enterprise, so data regarding components needs to flow up to the manufacturer from its supply chain. For digital data to live along a physical product, it means starting early, establishing a digital thread from design and engineering through production to service as well as from the supply chain, accumulating it throughout the product lifecycle, including deviations and engineering changes. The value of data associated with the product is critical to provide these new service levels and meet new customer demands.

“It’s a race to see who gets to market first with a new smart manufacturing ecosystem,” says Leiva. “This way of doing business will disrupt markets and those manufacturers

that realize the smart manufacturing strategy early will have a decided advantage over laggards.”

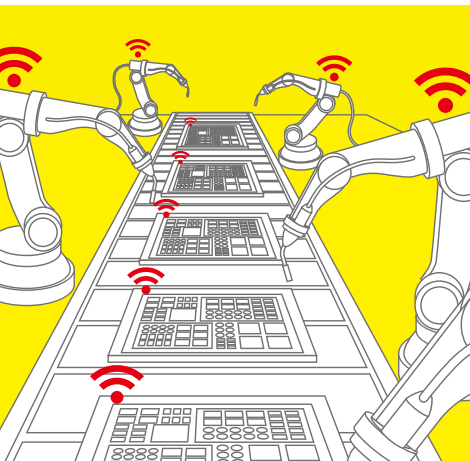
The Smart Manufacturing Roadmap

The MESA organization has put forward a roadmap to smart manufacturing. It consists of five layers, with connected things at the base, leading up through connective technologies, streamlined processes and empowered teams, to business strategy.

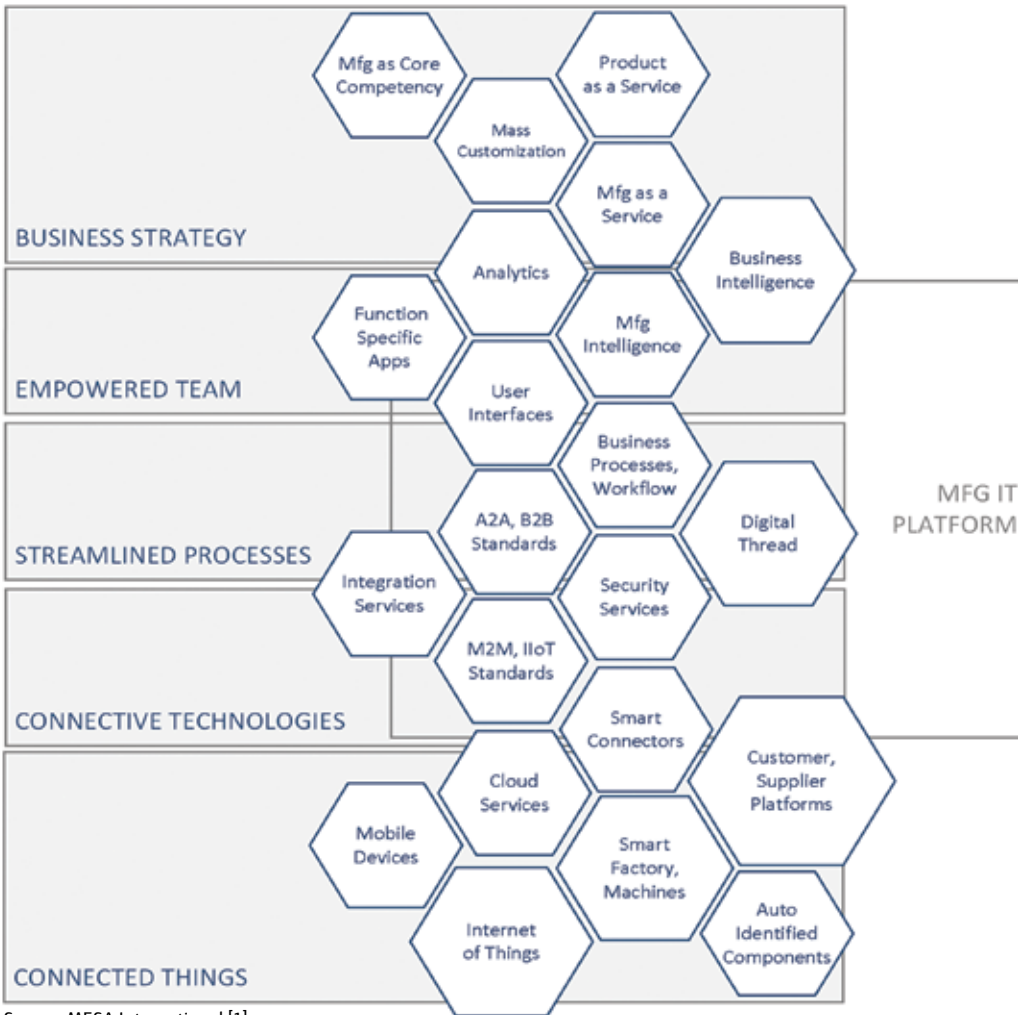
New connected technologies and equipment are the foundation of the roadmap. However, the most important takeaway is that the vision is only realized when the pieces are organized to enable new connected business processes and information that generates breakthrough manufacturing business strategies.

“The manufacturing IT platform gets you from connected things to business strategy,” notes Leiva. Manufacturers and their partners are working to assemble the framework and platforms to realize smart manufacturing. They’re identifying all areas where connectivity is weak, where manual or unstructured data handover occurs, so they can move to more structured and standards-based data exchange.

“It’s all about the ‘language’ we’ll use to interact, and how the data will flow in the product value chain,” Leiva continues. “When



“Smart manufacturing is an initiative similar to lean manufacturing. It’s a journey of connectivity and orchestration that’s going to take the next decade or two.”



Source: MESA International [1]

you’re talking about a multi-tiered supply chain, you can’t just rely on a single brand strategy. You need to connect all parties and their systems and they need to talk the same ‘language’ to have a common understanding and properly map the data.”

Because of the need for a multi-vendor solution (i.e., communicating data seamlessly across all vendors in the supply chain and their systems), a standards-based means of communication is needed. Standards have developed more rapidly in procurement (e.g., with EDI) than in engineering, quality, or

production. Those functional areas have the greatest need to mature in terms of integration standards.

What Manufacturers (and Their Suppliers) Need to Do

As indicated by the smart manufacturing roadmap above, manufacturers need to start thinking about the infrastructure needed to acquire the digital information and pass it around in the digital thread. They need to look at the different levels where they have digital information,

understand where they don't, and move rapidly from manual or paper processes to digitally connected processes.

"You need digital information to pass to systems that will automate the analysis of data for decision making — the new generation of analytics and business intelligence," says Leiva. He cites three specific areas manufacturers should reconsider as they move towards implementing smart manufacturing practices:

- **Reimagine the customer journey.** Think in terms of 1:1 customer relations, not customers en masse. Reward and incent the channel in new ways. Deliver new value to the customer with connected products.
- **Redesign operational processes.** Make automation processes faster and integrated throughout the enterprise. Create a digital thread of connected data through the product lifecycle. Maintain equipment predictably and proactively.
- **Challenge business models.** Leverage connected things and data to increase quality, output, and revenue. Augment physical experiences with digital ones. Move from a product-centric to services-centric organization. Incorporate product and usage data into new marketed services.

The digital thread is a single, unbroken thread of critical data and information throughout the value chain that is accessible to all stakeholders across the extended ecosystem. The thread ensures complete visibility and traceability from design and suppliers through production, and ultimately to the end user or customer.

For the manufacturer, the digital thread enables better and faster decision making

across the extended enterprise. By delivering all necessary information in context, the digital thread facilitates improvement in speed-to-innovation, productivity, quality, KPIs, and, ultimately, profitability.

For the product consumer, the digital thread allows the product's data to continue into its service life and help improve its service performance.

The Need for New Skills and Cultural Change

Beyond assessing and addressing the IT infrastructure needs for smart manufacturing, manufacturers need to analyze the skills needed to implement the strategy. Cultural changes will be necessary in many cases; the "not invented here" mentality needs to be eradicated, as the smart manufacturing enterprise requires collaboration across its value networks. Building relationships that create new services for customers will be key, and such alliance management will take on a much more important role in the enterprise.

Of course, this collaborative orientation extends to IT and information systems. Silos must go. There will be more horizontal management of application programming interface (API) layers, as well as data exchange standards across the enterprise and supply chain. Governance of data will extend from inside the company downstream to the supply chain and upstream to the customer; for this to happen, traditional walls must be torn down.

Shop floor skill sets will have to change, too. The workforce will need to be more educated and flexible, and will need to be able to work well with third parties. Workers will need to learn how to configure and maintain smart machines and robots. IT personnel will need to learn about manu-

One of the principal drivers of smart manufacturing is the imperative for companies to create more products, more custom products, and services delivered around those products.

facturing systems, protocols for equipment integration, and how manufacturing data flows into business intelligence and corporate metrics.

“It’s not someone just wielding a wrench anymore,” says Leiva. “The new workforce will be a combination of highly skilled employees and third-party contractors who maintain really sophisticated equipment, but above all understand the importance of information. In the smart manufacturing enterprise, equipment will do more and fewer employees will handle more areas. They will need to be excellent communicators as well as have a good understanding of digital technologies.”

The need for exceptional communications rises from the workforce to the enterprise itself, as collaborative processes increasingly become key to operational excellence and competitive standing. “Creating a more collaborative supply chain is essential,” says Leiva. “Everyone is now a service provider; they’re not just product providers.”

Every tier of the supply chain will become more invested in this collaborative orientation, with participants realizing that they play a key role in the end service provided and value delivered by the entire value chain. This will become increasingly clear as smart manufacturing strategies progress.

“The old mentality of ‘delivered then forgotten’ created some natural distance between participants in the value chain,” says Leiva. “With those walls gone, a new door

opens for more collaborative attitudes and another gap closes on the path to smart manufacturing.”

Preparing for the Smart Manufacturing Future

As manufacturers look to establish a new culture of connected transparency and collaboration across the supply chain to the end customer, there are a number of basic steps to take in preparation:

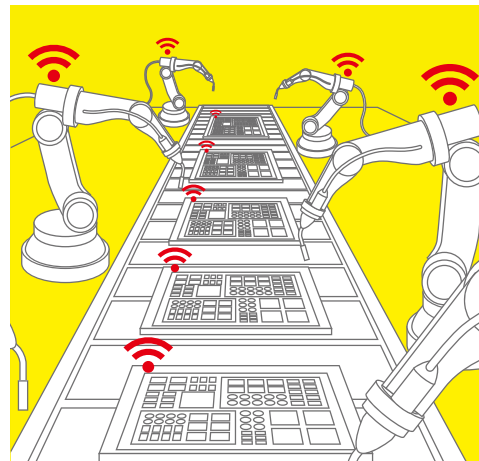
- **Identify a few small initiatives.** Even though an enterprise wants to move rapidly to smart manufacturing, it’s unrealistic to expect the transition to be one giant step. Begin the process incrementally. Identify an area within one of the five layers in the smart manufacturing roadmap where a gap exists. Set up an initiative to close it. Begin the process of establishing the necessary infrastructure.
- **Engage customers early.** Customers are the ultimate beneficiaries of a smart manufacturing strategy, as it facilitates meeting their demands for more customized products and innovation. Let your customers know of the changes you’re implementing as you move down the path to smart manufacturing. They’ll support you—and that support will help propel and sustain you over the journey.
- **Recalibrate business processes and models.** After all, this is an industrial revolution. You can’t expect the processes

References

[1] “MESA White Paper #52: Smart Manufacturing - The Landscape Explained”, MESA.org, 2016

<https://services.mesa.org/resource/library/ShowResource/b2bf9cb9-8c1c-4ccc-8877-7cdab-4f9e787>

The most important thing about smart manufacturing is that its vision is realized only when the pieces are organized in such a way as to enable breakthrough strategies.



and models that supported the organization before smart manufacturing to remain valid after its implementation. Things must change. Assess and adjust all your business processes and models to accommodate the new way of doing business.

- **Develop an experimental mindset.** Manufacturing companies almost always had the mindset that they needed to build capital-intensive products and systems to give them an enduring competitive advantage. This led to a proprietary approach to the market and a focus on the big product, an approach rendered obsolete in an age of accelerating innovation and the demand for customized goods. Instead, establish an experimental mindset to constantly iterate and develop new products and solutions to meet the demand for rapid innovation.
- **Develop partnerships.** In the smart manufacturing world, manufacturers go to market less as isolated entities and more as part of a value chain that goes to market jointly. Developing partnerships with forward-looking firms (even some you may have considered competitors previously) will go a long way in creating business value.

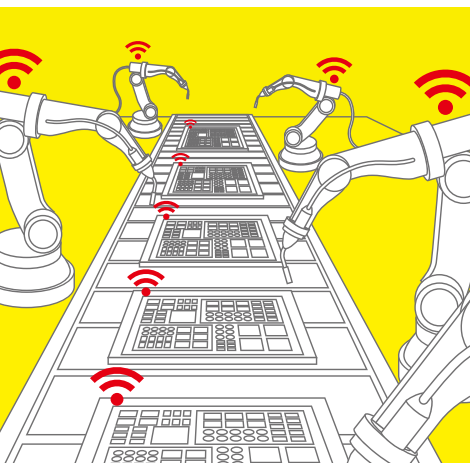
Smart manufacturing is about establishing a manufacturing ecosystem, a value chain of partners and suppliers that bring value (product and services) to the marketplace together. This will demand further work on

establishing standards that enable seamless communication across the value chain. Consequently, participating in and keeping informed of the standards work being done by industry and government consortiums will be critical in enabling effective communications across global value chains.

The promises of smart manufacturing should serve as motivation as the transition work continues:

- New levels of efficiency to support new services and business models
- End-to-end value chain visibility for each product, connecting a manufacturer to customers and the supplier network
- Configure to single custom orders
- Design anywhere; build anywhere
- Autonomous and distributed decision support
- Data-based and analytics-based decision making
- Genealogy accessible by product owner
- Multi-vendor hardware and software plug-and-play

The renowned software engineer Watts Humphrey once observed, “Innovation is the process of turning ideas into manufacturable and marketable form.” By speeding and streamlining that process, smart manufacturing will realize the next industrial revolution everyone is talking about. The time for talk has become the time for action; those who start taking that action will lead manufacturing in the coming years. **M**



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