# Smart Factory Implementation: How Smart Is Smart Enough?

## SMT Prospects & Perspectives

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As we are moving further into the Industry 4.0 era, rigidity is out, and flexibility is in; stiffness is out, and agility is in; sluggishness is out, and swiftness is in. Responding to the evolving new industrial enterprise—delivering customized products with flexible, modular production flow at optimal economics—becomes necessary. Manufacturing companies need to develop a thorough understanding of the available technologies that can be utilized to translate business objectives into business roadmaps targeting operational excellence to produce competitive, reliable, and economical products that perform in a timely fashion in the marketplace.

One of the beautiful fruits that Industry 4.0 bears is intelligent manufacturing, which, in turn, is manifested in smart factories. It was reported that about half the activities people are paid to do globally could potentially be automated using technologies that exist today [1]. Yes, we need automation, yet the smart factory is not merely an automation system nor robotic operation. "Smart" comes from the utilization of technologies that are available at our disposal; this includes artificial intelligence (AI), robotics, analytics, big data, the internet of things (IoT), and the advanced network technology (5G and higher).

As the factory of the future, a smart factory is expected not only to run essentially autonomously without human intervention, but also to learn and adapt in real-time with self-correcting and self-optimizing ability. Smart factories lead to a production environment in which production facilities and logistics systems are

synchronized without the need for human tasks. Accordingly, visibility, traceability, predictability, and sophisticated simulations—coupled with speed, agility, and flexibility—are the underlying characteristics of intelligent manufacturing.

In practice, the ultimate manufacturing merits—faster delivery, customized products, less waste, higher yield, lower cost, and on-demand production—can be achieved by a smart factory. As a result, production defects are prevented; preventive maintenance can be pre-scheduled; supply-chain efficiency is optimized; and new product innovation is facilitated.

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This on-demand production can only be accomplished by seamlessly leveraging the powerful tools of a cyber-physical system—namely, AI, IoT, and data analytics. Cyber-physical systems communicate with each other using IoT enabled machine-to-machine communication, machine-to-human interaction. With connected IoT devices, factories can gather data in real-time. AI capable of collecting and processing a colossally large volume of data can analyze the data to provide intelligence based on analytical algorithms. With the convergence of AI and IoT, an intelligent network of devices can be created, capable of gathering and analyzing data remotely and translating that data into intelligence and actionable steps locally.

For example, AI can identify quality problems, such as detecting missing circuit board components and making necessary remediations. It can also analyze data from raw materials, production lines, finished products, maintenance records, and customer complaints. IoT can capture data on workers' safety, energy usage, temperature, and output. IoT devices can also be outfitted on checkpoints in the distribution process, where they can keep track of parts and products as they are shipped from factory to warehouse and beyond. This also enables the formulation of reliable inventory forecasts, the avoidance of unscheduled downtimes, and the timely reaction to unexpected changes in the production line.

Factories' ability to keep track and control of inventory in the actual dollar value of inventory and days of inventory is crucial to the bottom line of a company. Doing well in this area mitigates the mishap of production outpacing demand as well as eschews cash flow traps. Using cyber-physical systems, supply chains will be fully integrated and automated. Cyber-physical systems deployed throughout the value chain generate the linkage between data and material flows, creating the complete visibility of the supply chain, in stationary or in transit state. In maintenance, the connected, intelligent machines can trigger maintenance processes autonomously. Data analytics aids the detection of process inefficiencies, thus reducing production costs. IoT sensors embedded within the products and machines provide information about actual product performance during their service life through data exchange between the production line and the product. Combining data generated and analytics employed offers the capability in predictive maintenance and quality. Additionally, how customers use the products can be monitored, which helps companies in customer services, warranty management, as well as product design.

Cellular technology (5G or more advanced) and augmented vision play a key role as well. The network enables a large number of machines and robots (when applicable) to be connected to the local boutique net-

works at higher speeds, using smaller antennas. Advanced sensor technology and other embedded technology aid the materialization of unmanned operation in pertinent functions, offering flexibility of on-demand production throughput.

Benefits are evidently abundant, yet challenges tenaciously remain.

With the massive amounts of data from different checkpoints, the challenge in data management takes the front and center seat, including ensuring the quality of data, classifying the data, cleaning the data, interpreting the data, and analyzing the data. The ready availability of workers who have suitable skill sets is another challenge. Although AI serves as the eyes and ears of factory operation and can learn quickly to alert irregularities and to initiate remedial actions, it has to be "trained" and to gain "experiences" to do the job well, such as recognizing production defects without misses and with required accuracy to gain the ability to know when and how to alert humans for necessary intervention.

To put a business case forward, a smart factory will be able to be smart enough to deliver intended beneficial results. Then, the question becomes, "How smart is smart enough to a specific operation?"

Each company (or operation) needs to formulate its plan to garner the merits of intelligent manufacturing in establishing a smart factory. As AI and sensor technology continue to evolve, staying in sync with the technologies demands systematic, deliberate, and prudent endeavors. **SMT007**

## Reference

1. J. Manyika, M. Chui, M. Miremadi, J. Bughin, K. George, P. Willmott, & M. Dewhurst, "Harnessing Automation for a Future That Works," McKinsey Global Institute, January 2017.

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