The vision of industrial autonomy as a next evolutionary step beyond mere automation for the process manufacturing industries continues to gather momentum. But autonomous operations isn’t just a step change from the current status quo. Rather, it describes a destination that passes through fully realized automation in the traditional sense, followed by increasingly “smart” manufacturing, that is, automation that leverages integrated information flows across the enterprise as well as artificial intelligence (AI) and other digital technologies to intelligently adapt and respond to changing process conditions, often—for the moment, at least—under the supervision of a human operator.

Progress toward the development and adoption of autonomous vehicles is in many ways analogous to the journey upon which industry has embarked. Many cars already are quite intelligent, for example, and have subsystems like automatic brakes that draw on sensor information to respond independently to unexpected but narrowly defined conditions. Indeed, the automotive industry has been adding intelligent systems that also allow automated parallel parking, lane alerts, reactive cruise control and supervised, semi-autonomous highway driving. Meanwhile, the fully driverless car has been slower to arrive than many anticipated simply because of the far broader array of information about its surroundings that the fully driverless car must sense, understand and respond to.

And if one considers the even greater diversity of operational tasks that a refinery or larger chemical plant entails—from the control room to the field to planning and scheduling—then fully autonomous plant operations are a bit further into the future
than they are for cars. But industry will clearly continue to take strides in that direction, realizing smarter and more semi-autonomous subsystems that allow human operators to focus on higher level tasks and our automation systems to control processes closer to optimum in response to a broader array of changing conditions.

**Digital transformation begets smarter manufacturing**

Of late, smart manufacturing strategies and implementations have fallen under the descriptive umbrella of “digital transformation” of the production and value chain. Increasingly, production assets are vertically integrated with enterprise processes and horizontally connected across the value chain so production systems are capable of interacting with other systems (Figure 1). The deployment of AI and cognitive systems enable smart manufacturers to support adaptive and self-optimizing responses to changes in demand and customer requirements in real-time, allowing for semi-autonomous operations across a series of devices, equipment and production systems.

*Figure 1. The first step toward smarter process manufacturing requires the integration of IIoT systems with legacy automation platforms and other enterprise systems.*
Digital technologies are, of course, critical to achieving smart manufacturing and autonomy. Today, a typical production facilities utilizes numerous operational technology (OT) devices, equipment and control mechanism that often operate in relative isolation and communicate using a variety of niche protocols. This creates data silos, integration and information-exchange difficulties as well as procedural inefficiencies. A smart manufacturing approach features a blended, hybrid architecture that connects on premise, Industrial IoT (IIoT) devices to cloud-based systems, complementing legacy systems and allows better management of data.

**Smart comes first, then autonomous**

Process manufacturers are at the beginning stages of their journey towards autonomous operations. Numerous application-specific, autonomous sub-systems have been developed to help organizations realize their smart manufacturing goals and objectives. Some of these systems focus on predicting process and equipment anomalies, determining root causes, predicting product quality issues, and performing optimized process control. Other applications analyze plant-floor data to feed advisory, decision-support dashboards to realize profit-driven operations.

Across the process manufacturing industries, maturity levels vary with regard to digital transformation and adoption of smart manufacturing methodologies. Companies must assess where they are today and, based on their business objectives and strategy, determine where they want to be in the future, then map out the best way to get there.

In the near-term, completely autonomous facilities are unlikely. However, companies are implementing increasingly smart systems to provide higher levels of productivity, flexibility, reliability and profitability while addressing their sustainability development goals. And if past is prelude, ever smarter systems are sure to be followed by increasingly autonomous ones.

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