

Driving Higher Levels of Flexibility, Productivity, and Sustainability in Smart Manufacturing

Thought Leadership Article

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Driving Higher Levels of Flexibility, Productivity, and Sustainability in Smart Manufacturing

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The Importance of Intelligent Motion Control in Smart Manufacturing

Intelligent motion control is the core building block of smart manufacturing enabling highly flexible and efficient manufacturing. Intelligent motion control combines precision feedback, advanced sensing, high performance control, and seamless connectivity to deliver deterministic motion solutions. Seamless connectivity of motion insights to PLCs and manufacturing execution systems (MES) allows advanced analytics to optimize manufacturing flows and identify potential issues before production stops. Smart manufacturing using intelligent motion control can be reconfigured quickly to support more agile and scalable manufacturing, including batch size 1 production. By reducing the time to complete a manufacturing step and optimizing the manufacturing flow for higher throughput, less energy is consumed resulting in more sustainable smart manufacturing. Intelligent motion applications include:

- Pumps
- Fans
- Hoists
- HVAC
- Conveyors
- Weighing
- Printing
- Extrusion
- Machining
- Robotics
- Pick and place
- Handling, and many others

The Evolution of Intelligent Motion Control Solutions

Motion control has evolved over time from simple grid connected motors to complex multi-axis servo drives for machine tools and industrial robots. This evolution has been accelerated by the increasing complexity of automation required to deliver higher levels of productivity, flexibility, and economy in smart manufacturing (see Figure 1).

Grid-Connected Motor

The most basic motion solutions are based on a grid connected or AC powered, 3 phase fixed speed motor that uses a switchgear to provide output control and protection capability. These basic motion solutions run at a relatively fixed speed independent of any load variation. A reduction in output is implemented with mechanical control—brakes, clutches, gears or valves, pumps, and fans are some typical asset examples.

Inverter Driven Motor

The addition of a rectifier, DC bus, and a 3 phase inverter stage in effect creates a variable frequency and variable voltage source that is now applied to the motor to enable variable speed control. This inverter driven motor enables significant reduction in energy consumption by running the motor at the optimum speed for the load and application. Examples include higher efficiency pumps and fans.

Variable Speed Drive

For higher performance motion control applications, a variable speed drive (VSD) enables accurate torque, velocity, and position control. To achieve this, current and position measurement are added to the basic open-loop inverter drive. More precise control of motor velocity, position, and torque is then possible. Conveyors, winding, printing, and extrusion machinery are typical examples of these applications.

Servo-Driven Systems

Synchronized multi-axis servo-driven systems are used in more complex motion applications. Machine tools and CNC machines require synchronization of multiple axes with extremely accurate position feedback. In CNC machining, 5 axis coordination is common, although there are applications that utilize up to 12 axes in which tools and workpieces are both being moved with respect to each other in space.

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