Distributed Control Enables Manufacturing Agility

Modular Design Boosts Engineering and Operational Efficiency

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Decentralized Controls in Manufacturing
Overcoming the Skilled Labor Shortage

Many industrialized countries are facing a critical shortage of high-tech engineers. According to the U.S. Bureau of Labor Statistics, between 2016 and 2026, there has been and will be a shortfall of about 6 million engineers.

In the latest report by Deloitte and the Manufacturing Institute, as many as 2.1 million manufacturing jobs will be unfilled through 2030.

What Can You Do?
With these looming statistics, manufacturers face enormous pressure to stay competitive. To combat these labor challenges, many companies are increasingly choosing new technologies that expand productivity, decrease labor and engineering costs, increase uptime, and slash error rates.

One way to achieve this is through a distributed control architecture, comprised of a network of interconnected controllers, computers, and other automation devices used to monitor and precisely control production processes.

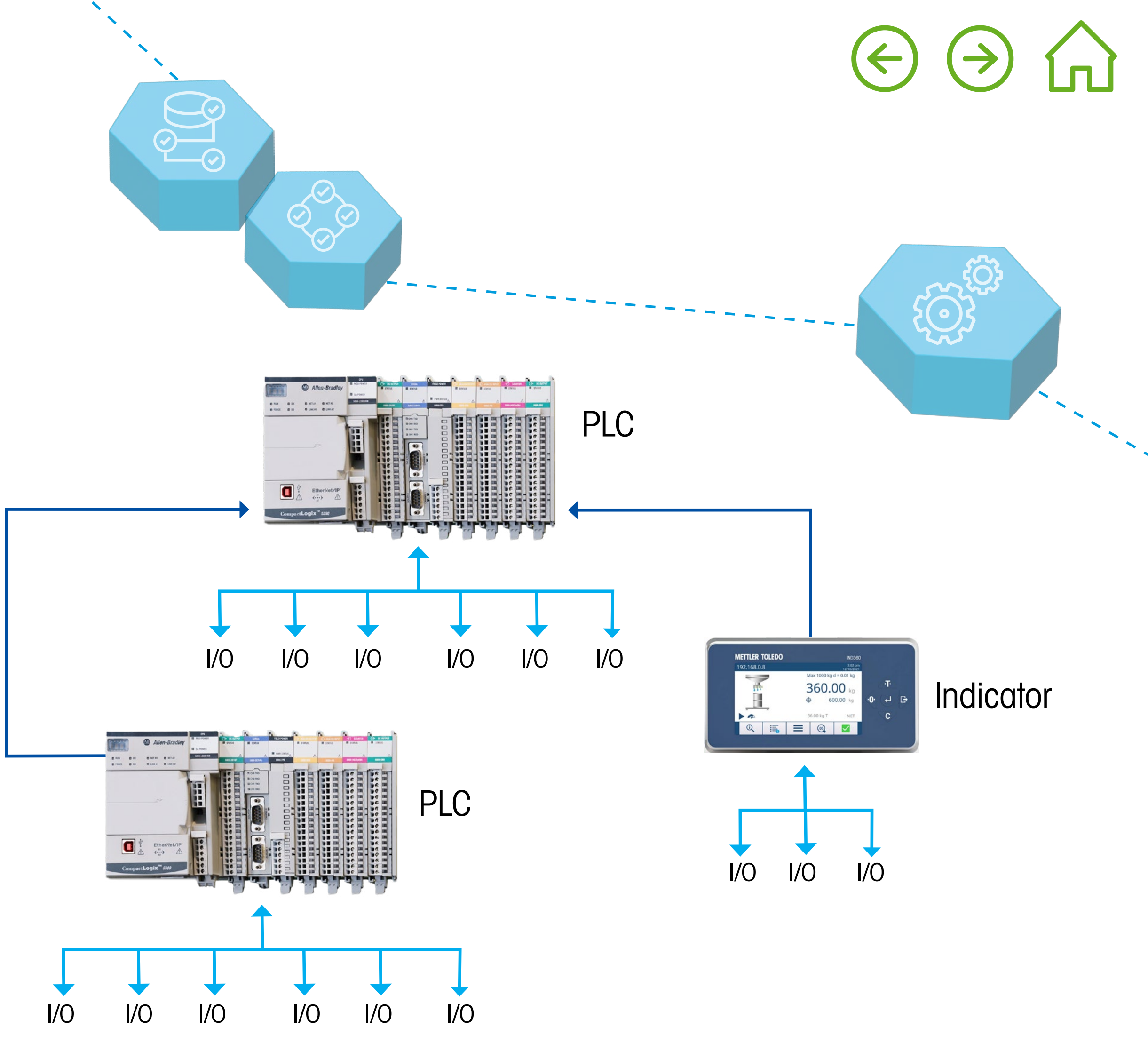


Figure 1: Example mapping of a distributed control architecture.

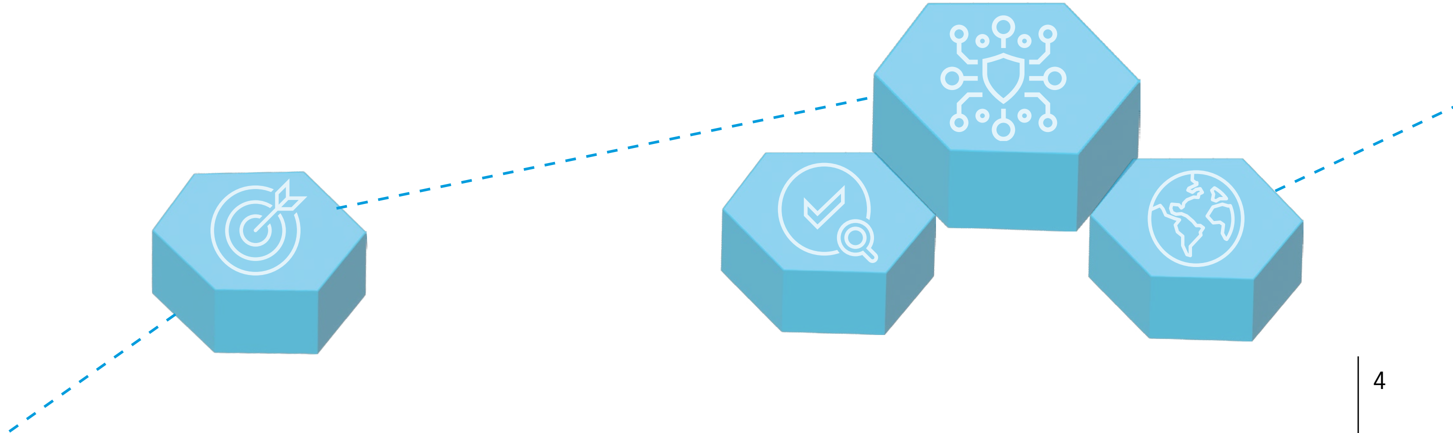
Distributed Control with Wide Applications

Enables Much Faster Weighing

Distributed control is a design principle consisting of modular, self-contained control elements throughout the plant or control area. It differs from centralized control where a single controller at a central location handles all control functions. In a distributed architecture, each process element, machine, or group of machines is controlled by a dedicated controller (Figure 1).

The subsystems may be either local PLCs, or instrumentation with control capabilities optimized for a specific function. Adding domain-specific controllers delivers numerous benefits such as faster reaction time, increased machine speeds, and improved productivity and efficiency.

The local controllers in various sections of the plant are connected via a high-speed communication network such as EtherNet/ IP™, enabling the controllers to exchange information with each other and to higher hierarchical levels. Defining the responsibilities, data flow, and command structure is key to properly organizing a distributed system that also includes human-machine interfaces (HMIs), printers, and network switches.



Advantages of Modular, Distributed Systems

Optimizing Production Processes

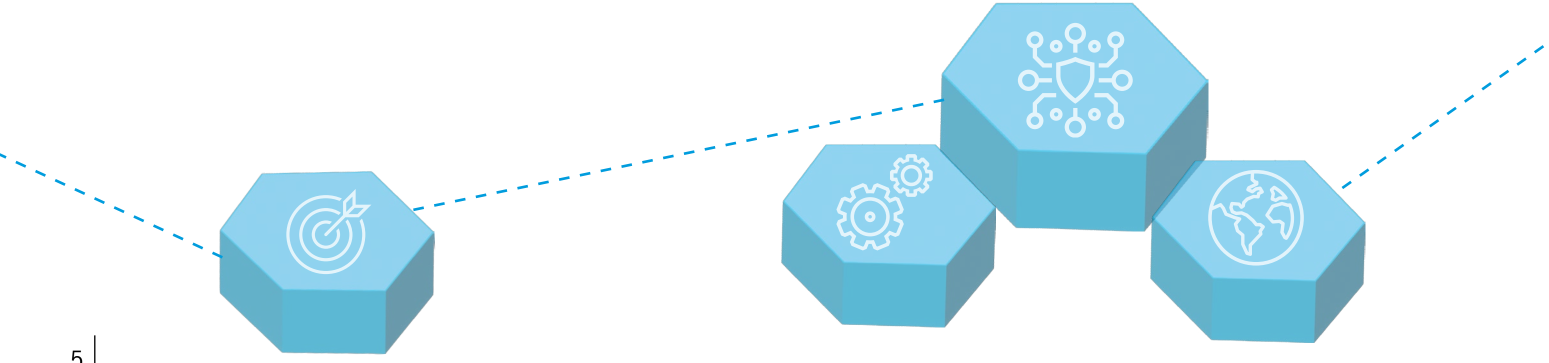
Splitting the entire system into logical building blocks with their own monitoring and control provides many advantages, including:

- Preprogrammed applications reduce engineering costs.
- Modular design minimizes complexity, and problems are easy to localize and identify.
- Commissioning is faster due to less wiring to main control cabinet.
- Overall system effectiveness is enhanced because each machine shares a portion of the control function.
- Modular design increases flexibility to build individual components independently.

Parallels in IT Infrastructure

A comparable architecture shift has already taken place in IT with the server infrastructure moving away from large mainframe systems to distributed computing. This move has occurred because mainframes are ineffective and expensive in the context of increasing data throughput and workloads.

Like in this IT change, operations technology (OT) developers discovered processing speed and reliability were immediate benefits when moving from a centralized to decentralized design.



Benefits for Weighing Automation

Optimize Filling and Dosing Processes

The process of filling packages and containers using distributed control is an excellent example to illustrate its benefits.

Weight-based filling is one of the most accurate, high-speed filling methods. The core filling process is handled by the weight indicator while allowing the control commands and monitoring to be done by the PLC. The interface between the two devices is well defined, and the weight indicator utilizes a state machine for synchronization.

In-Process Benefits

A key advantage of the distributed approach is that the control loop involving the sensor and actuators is handled by the weight indicator. This gives a fast and guaranteed reaction time for cutoff, which is critical for filling accuracy and makes the time required in slow-feed mode shorter or eliminates the need for slow-feed entirely. This reduces complexity and saves hardware costs.

Benefits for System Engineering

As an added advantage, the weight indicator uses self-optimizing, preprogrammed filling control algorithms that reduce development time, testing, debugging, and local HMI design. Also, when it comes to troubleshooting, isolating the problem to a particular module helps to expedite the process.

The electrical wiring between weight sensor, weight indicator, and actuators is all local to the filling station, and a filling cycle could even be triggered manually to ensure that the filling module is operational.

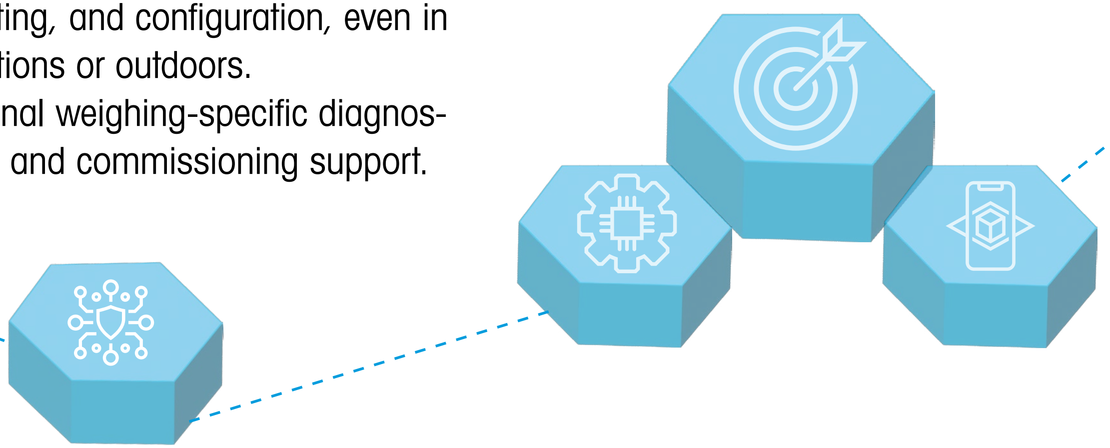
Benefits for Weighing Automation
Simplify Inventory Control

Using distributed architecture also provides benefits for weight-based inventory control, which is contact free and highly accurate, and the weighing sensor can be maintained externally.

Advantages of a self-contained weight-based inventory control system include:

- Control the valve or pump to automatically refill local buffer tanks from the main storage tank.
- A local display enables status monitoring, troubleshooting, and configuration, even in remote locations or outdoors.
- Gain additional weighing-specific diagnostic functions and commissioning support.
- Alert the operator, such as through a directly connected indicator light, and higher-level systems in the event lower or upper limits are violated.
- Report inventory and status information back to the control system and/or IT system

As with filling, this functionality is preprogrammed and ready to use on the weight indicator, saving valuable engineering time.



Streamlining IT/OT Convergence with Distributed Control

Enhancing Connectivity and Competitiveness in Manufacturing

IT and OT convergence is a hot topic in many evolving industries. IT is the technology backbone used for data acquisition and analysis, whereas OT is for real-time control. Historically, these systems operated autonomously and required substantial human intervention to transfer data from one system to the next. This is changing as IT enters the factory floor to directly capture the data.

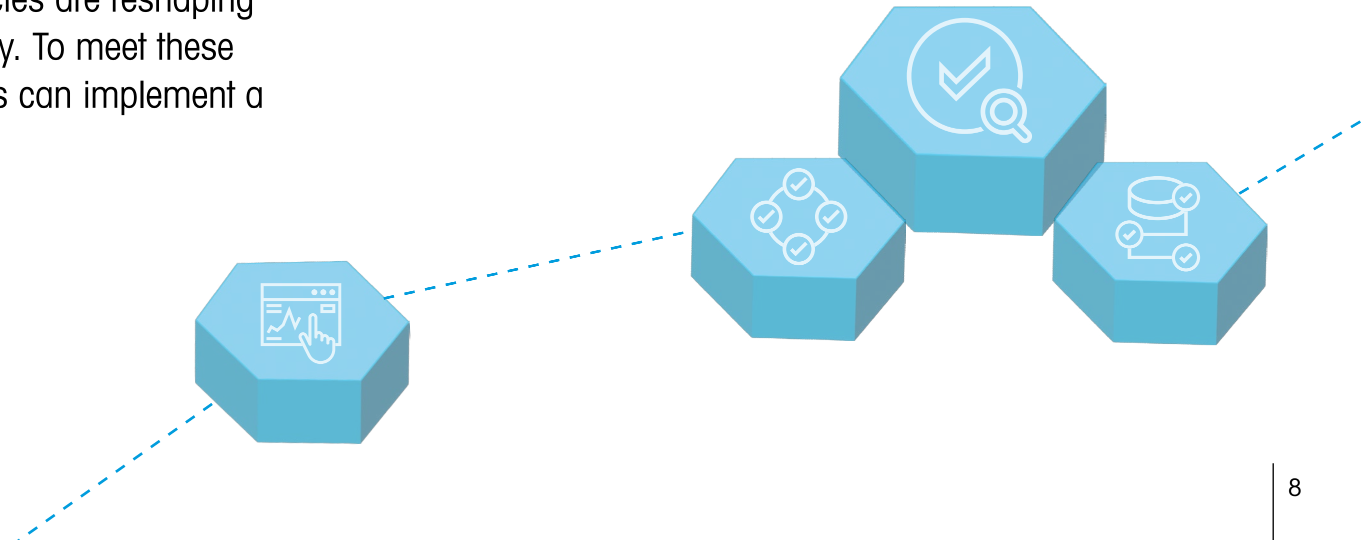
A module in the distributed control setup can connect to IT and OT systems independently instead of relying on one central system to handle all data and workload. Real-time data is transmitted within the PLC/controller network for operation-critical activities, and analytical data is locally preprocessed and transmitted through the IT channel.

This results in clean architecture of two separate networks without interference and is the basis for implementing independent security policies on the two networks.

Staying Competitive

Rapid globalization, technological advancements, changing consumer preferences, and evolving government policies are reshaping the manufacturing industry. To meet these challenges, manufacturers can implement a distributed control system to reduce engineering costs, simplify maintenance, and increase productivity.

Distributed control is well suited in many areas, such as weight-based filling where fast reaction times as well as domain-specific algorithms lead to best-in-class results. The connectivity to both OT networks for control and IT networks for analytics is also covered to provide the most flexibility.



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