I/O Implementations

Consider rip and replace, think modularly, don't hardwire, and save up to 75% in your next system upgrade.

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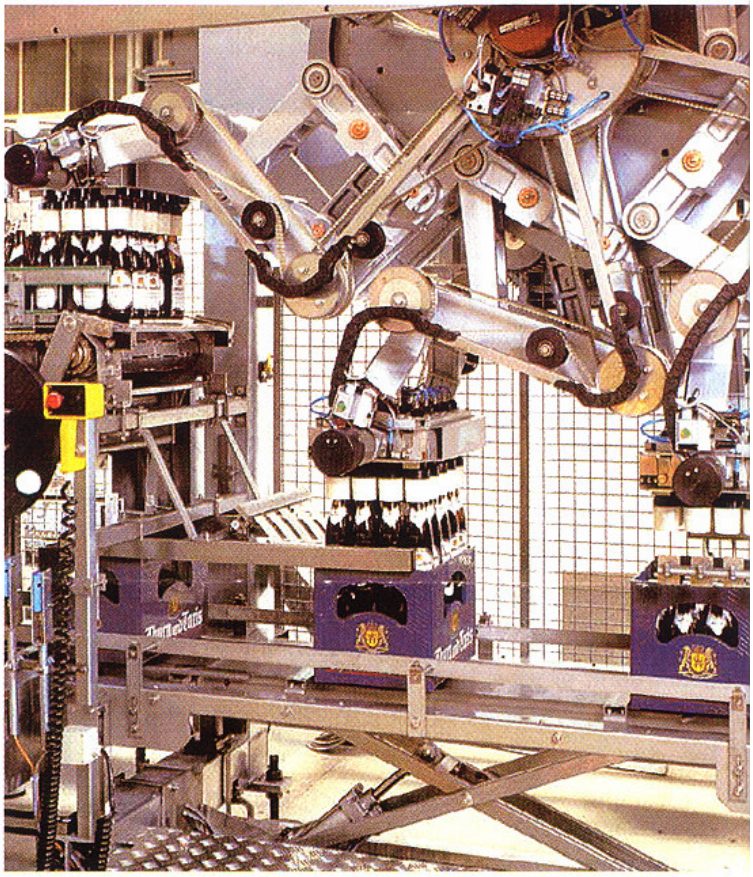
Control Engineering

Replacing I/O connections is often seen as the least-desirable automation upgrade in the facility. Those regularly involved in implementations can offer advice to ease the pain in replacing the I/O glue between manufacturing processes and control systems. And, in some cases, the I/O system even can become the control system.

Reasons for a major I/O upgrade include lack of replacement parts, and need for additional capabilities or greater functionality unavailable in the old system. It can also "reduce costs and improve overall reliability and maintenance," says Bill Griffith, GE Fanuc CNC product manager. Such an upgrade can add strength to customers' competitive positions to help them grow their businesses.



Brewery bottling line includes modular I/O connections, allowing quick change-out of end effectors (robotic grippers) as the application requires. Hardwiring limits flexibility.

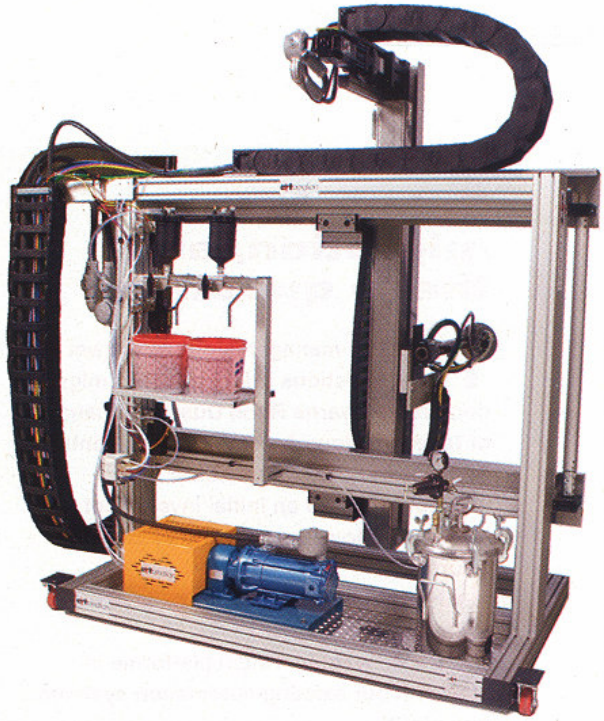
AT A GLANCE

- **Input/output systems**
- **Modular capabilities**
- **Easier connections**
- **Greater reliability**
- **Granular, with logic**

I/O replacement reasons, says Tom Edwards, Opto 22 senior application engineer, include a need to change vendors, follow a corporate mandate, lower costs, migrate from a serial-based industrial network to Ethernet (for increased speed, more communications options, and other benefits), and add connections with greater density. Most-desired functionalities include data logging, wireless, and compatibility with PC-based systems, he says.

Prospective customers should check a vendor's migration history, Edwards explains, and "remember there are scenarios where you can upgrade your I/O without necessarily replacing/ripping out all your modules, racks, sensors, actuators, and wiring. Explore this possibility to see if it's an option." Also, don't sign any unwanted long-term contracts for maintenance, service, and support, he warns.

Before upgrading an I/O system, says Chuck Greene, vp product development, Artomation by Digital Coating Devices Inc., project scope must be defined. A process engineer upgrading an in-plant I/O system may not be concerned about global availability, while an OEM shipping industrial controllers may consider availability a top priority, he says. Factors such as fieldbus type(s), I/O location, serviceability, and importance of operation will factor in.



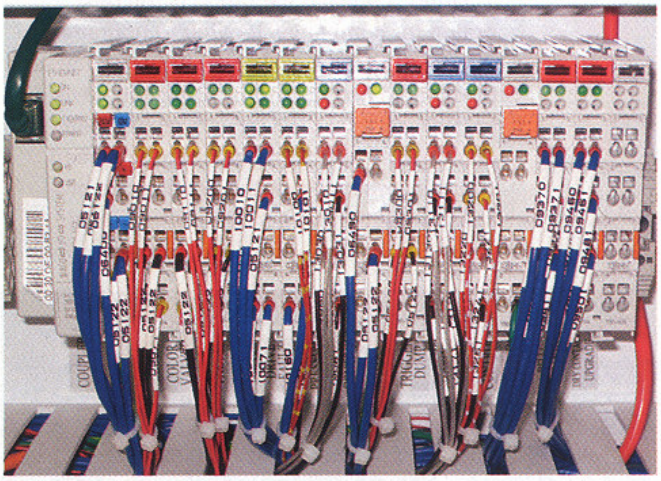
An Artomation PanelPro painting machine can vary in configuration depending on customer needs. Any Wago digital, analog, or specialty modules can be added as needed, without PLC configuration.

I/O upgrades can include substantial advantages in staying with the same vendor for probable migration strategies, migration technology built into new products, or migration hardware and/or software tools to facilitate the process, says Robb Dussault, manager of Telemecanique automation and control services at Schneider Electric. "Using this first-hand knowledge saves development and installation time, component costs, and most importantly, it reduces risk." Blazing new trails can lead to incompatibilities, Dussault suggests.

Also, companies need to evaluate whether a complete, phased, or partial migration is best for operations. To choose the best method for migration, Dussault says, weigh long- and immediate-term investment with the long-term benefits and cost savings.

Generally, existing I/O connections are replaced only when all other methods fail, says Helge Hornis, intelligent-systems manager with Pepperl+Fuchs. Doing so adds flexibility, safety functionality, and other capabilities that digital networking and modular connections offer, he suggests.

I/O technology implementations illustrate reasoning behind undertaking replacements or upgrades.



Wago (750-842) programmable fieldbus coupler has a small footprint, which helped conserve panel space for an Artomation application.

Flexible robotics

A robot is supposed to handle a number of different end effectors (grippers), says Hornis. This allows users to manipulate different items using the same robot. On a flexible bottling line, using the AS-Interface digital network and different I/O connections, grippers can be quickly changed under power. The AS-Interface network, Hornis says, enables that flexibility, while hardwiring would not.

Painting with Artomation

Development of a new, more powerful human machine interface (HMI) led Artomation to a product redesign centered on the I/O system. The company is a Cleveland-based manufacturer of automated painting machines and systems. Scalability, versatility, and a price fit for resale were priorities, Artomation's Greene.

The old system was based on an industrial PC running a UNIX real-time operating system, Greene says. I/O cards were installed on the PC (ISA or PCI) bus. With the I/O connections on the PC bus, communication was fast and reliable. Additional I/O cards could be added without recompiling code. However, Green says, a card could be required to add just one I/O point. Each card required a breakout board for wiring. Both add to system cost. More importantly, a failure of the PC would cripple the system. Therefore, the redesign focused on distributed I/O points programmed (to IEC 61131-3 standards) to operate independently of the PC.

Backplane PLCs were considered for power, reliability, and availability, but planning for I/O expansion is difficult, Greene says; choosing an oversized backplane adds to project cost. Addition of I/O modules requires reconfiguration of the ladder logic, additional programming, and recompilation of code.

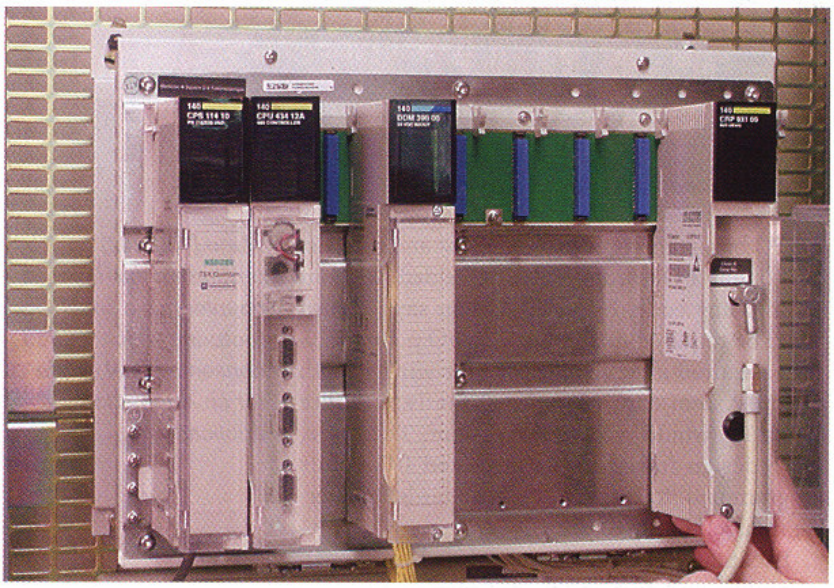
Artomation compared modular (non-backplane) PLCs and chose the Wago (750-842) programmable fieldbus coupler, Greene says. A small footprint helped conserve panel space. A large selection of digital and analog as well as

Before I/O migration, ask these questions

The facility manager needs to answer some questions prior to any I/O migration project, warns Robb Dussault, manager of Telemecanique Automation and Control Services at Schneider Electric.

- **How much of an initial investment do we want to make now and in the near future?**
- **How long can we afford to have the system down?**
- **Do we want to switch platforms or stay with our existing automation systems provider?**

Often, a phased migration is the best option for companies looking to upgrade the entire system while also reducing initial investment and downtime, Dussault advises. Phased migration takes a multiple-step approach to upgrading and can be spread over a number of months or years, so process disruptions are minimized, he says.



Schneider Electric Modicon 800 Series I/O modules allow users to replace one rack at a time instead of one point at a time, significantly reducing installation time and cost.

specialty modules (such as RS-485, high-speed counters) can be added in any configuration, simplifying specification and decreasing design time. I/O capability can be added without added configuration at the PLC level.

HMI tools were developed to provide easy system configuration and analog calibration, Greene says, cutting commission time by 30-40%. Fused ac/dc supplies with onboard power and fuse monitoring also increase diagnostic capabilities. Modules with pluggable field wiring can be replaced without tools, reducing downtime. Additional I/O points can be added for 1/10th the cost of a PC card, and no breakout board is required.

Phased migration

For example, Schneider Electric worked with South African Breweries (SAB) in Gauteng, South Africa, on a migration program, Dussault says.

SAB used a phased approach and chose to replace only the front-end Modicon processor first, which enabled SAB to install new I/O connections gradually over time. Eventually, this resulted in an overhauled control system, while maintaining a 24-hour operation.

Refining smarter

Chevron Corp. recently replaced I/O modules because more connections were needed. Opto 22's new Snap-AITM-8 thermocouple I/O modules have recently been deployed at Chevron's research laboratories in Richmond, CA, where technicians and scientists experiment with catalysts to trigger breakdown of crude oil and improve refining techniques. The Snap-AITM-8s accept up to eight channels of temperature or millivolt input from a variety of standard thermocouples.

At Chevron, they connect to many thermocouples that serve as process variable inputs to PID loops used for regulating temperatures during testing processes. New modules offered far more density, four times as much as their 2-channel predecessors. Enormous return on investment, and lower cost per I/O point resulted, say those involved. Chevron has deployed nearly a dozen I/O racks, each with twelve 8-channel AITM-8 thermocouple modules, 96 connections per rack.

Colonial efficiency

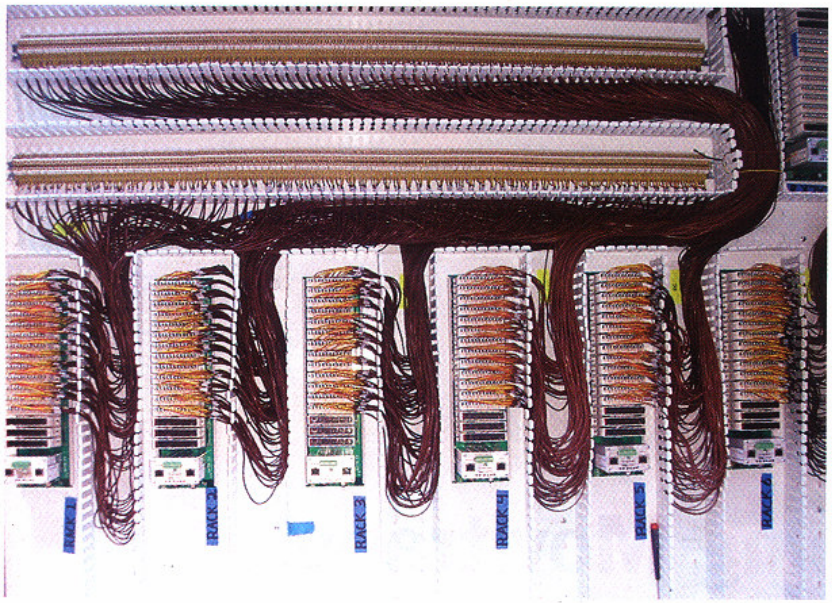
Difficult to install and maintain, centralized I/O architecture can cost up to 75% more than its distributed counterpart, say some engineers. But despite this figure, many companies are still struggling to say goodbye to long wiring runs and enclosures—including Colonial Group. For 80 years, Colonial has built its material-handling systems using a centralized control platform. Today, however, Colonial has joined a growing group of businesses migrating to a more cost-effective and efficient philosophy.

Founded in 1921, the Savannah, Georgia-based company stores and distributes a wide range of dry and liquid products for manufacturers globally. The company handles products such as kaolin and petroleum for a variety of

global industries (such as paper, automotive, agriculture, etc.) Combined, its facilities occupy more than 300 acres along the Savannah River, handling millions of tons of dry bulk and liquid products a year.

Colonial recently concluded that its centralized material-handling architecture wasn't providing necessary results. In addition to frequent installation and maintenance problems, the system didn't allow plant managers to gather device information or monitor diagnostics. As a result, the company was missing out on data that could help increase efficiency and improve the overall process. To rectify these shortcomings, Colonial opted to redesign a material-handling system intended for use in one of its newer facilities, Georgia Kaolin Terminals (GKT).

As the facility's name suggests, GKT handles kaolin, a mineral that is abundant throughout Georgia and processed by companies for use in applications such as paper, rubber, and paint. After installing a new, distributed system in the GKT facility, Colonial reduced installation costs by 15% and added ability to collect real-time diagnostics from variable frequency drives, motor controllers, I/O modules, and other smart devices from Rockwell Automation. **ce**



Chevron uses Opto 22 AITM-8 thermocouple modules and wiring.

For more information, visit

www.cesuppliersearch.com
www.controleng.com
www.gefanuc.com
www.opto22.com
www.am.pepperl-fuchs.com
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ONLINE

For more I/O technologies and applications, read this article online at www.controleng.com/archive, under September 2006.

How to repair I/O neglect

When upgrading a control system, advises Jerry Penick, Rockwell Automation engineer, replacing the I/O system usually means disturbing old and poorly documented field wiring and dealing with years of "panel neglect."

That's why engineers usually switch the I/O system as a last resort, Penick says, when the cost or ability to support old I/O connections demands it. However, migrating to new I/O connections can add benefits, such as an updated, faster network that supports higher density designs for the new I/O layout. To ensure success, there is no substitute for planning and good documentation before undertaking a project like this.

"Complete new I/O back panels offer the cleanest installation when you have either a scheduled shut-down or adequate replacement time," Penick says. "If there are time constraints, adding I/O [points] in adjacent enclosures or installing small 'distributed I/O' in an open space on the existing back panel can keep the system up and running until changeover time.

"To avoid creating a large panel rat's nest, you can also install your new distributed I/O close to the sensors and actuators–use current network technology to your advantage–and abandon the older bulky concentrated panels as you implement your crossover," Penick says.

For a smooth I/O transition, Rockwell Automation recommends:

- **Document and verify what and how things are presently wired;**
- **Before wiring changeover, try to install the new I/O system, verify the new network connection, and "ring out" the new I/O termination points;**
- **Ask the vendor about wiring block or "swing arm" adapters that allow old field wiring to be plugged into new I/O modules; this will ease the changeover; and**
- **Save space and time by installing small "distributed I/O" in the same enclosure to reduce the cut-over time.**