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Take advantage of the uniquely scalable and powerful PCS 7 platform featuring enhancements and new functions that will decrease your engineering time and operational costs. Version 8 is a testament on how we're listening to our customers and helping them meet their challenges. Rely on SIMATIC PCS 7 – performance you trust.

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Answers for industry.
Are you in control?

Naturally.

Of course you are. Your automation software is up-to-date and secure; new cost saving initiatives are in place; your control system is a model of efficiency and ergonomics driving productivity and collaboration to all-time highs.

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www.ProcessAutomationInsights.com
www.Youtube.com/user/ABBControlSystems
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by Jim Montague

WEB EXCLUSIVES


The Proof (test) is in the measurement.

Is safety important to you?
Solution for in-situ proof testing

When you utilize a safety system such as SIL, SIS or API2350, you are familiar with mandatory level instrument proof tests. Most require you to take your vessel off line and manipulate the level in the vessel or remove the instrument completely for testing. These methods typically:

- Require hours to complete the test
- Increase risk to personnel by placing maintenance staff on tall vessels
- Cost money due to extended down time and lost production

At Endress+Hauser, we can help you migrate to in-situ proof testing using free space radar, guided wave radar or vibrating tuning fork instruments installed in your safety system. This solution provides the ability to:

- Verify the health of the instrument and the associated wiring
- Significantly reduce downtime and the risk to your staff
- Improve your maintenance cycle, productivity and bottom line
- Provide up to SIL3 rating in overfill prevention with one device

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Too much chair time is bad for operator awareness and health.

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C-more operator touch panels offer:

- Clear TFT 65K color displays with 6 to 15-inch screens (6-inch STN models also available)
- Analog touch screen for maximum flexibility
- Easy-to-use software

Our C-more remote HMI application, for iPad®, iPhone® or iPod touch®, is available on the App Store for $4.99. It provides remote access and control to a C-more panel for mobile users who have a wi-fi or cellular connection.

C-more touch panels in 6” to 15” screen sizes are a practical way to give plant personnel easy access to controls and data. Check out the powerful yet easy-to-use configuration software by downloading a demo version at:

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ALL C-MORE PANELS INCLUDE:
- Analog resistive touch screen with unlimited touch areas
- One USB A-type and one USB B-type port
- Serial communications interface

FULL-FEATURED MODELS ADD:
- 10/100Base-T Ethernet communications
- CompactFlash slot for data logging

REMOTE ACCESS AND CONTROL BUILT-IN
- No Additional Hardware required. The C-more Remote Access feature resides in all panels with Ethernet support, and requires no option modules. Access real-time data or initiate an action on a control system from anywhere, any time. (Requires software and firmware version 2.4 or later*, and an Ethernet C-more panel)

C-more operator touch panels offer:

C-more® touch panel family:

6-inch STN grayscale
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8-inch TFT
10-inch TFT
12-inch TFT
15-inch TFT

Starting at:
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$540 (adds Ethernet)
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8 to 15-inch units include both serial and Ethernet ports

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Missing Links

In the process of exploring the current status of manufacturing technology, presenters at the recent ARC Forum highlighted a number of missing links: specific products, software and standards we need for industry to fully benefit from smart devices, pervasive sensing and the Internet of Things (IoT).

Perhaps the most specific was Sandy Vasser, facilities I&E manager, ExxonMobil Development Co. (www.exxonmobil.com), who exhorts his group to “challenge traditional approaches” for engineering and constructing automation projects. The group’s vision would eliminate marshalling cabinets, field programming and acceptance tests by automating device detection, identification, configuration, enablement and documentation, a strategy he calls DICED.

DICED-based designs will use a modular field junction box, built to company standards with a fixed set of smart I/O, to be purchased in quantities that exceed the anticipated I/O requirements of the project, and deployed on the site roughly according to the distribution of field devices. These junction boxes are connected directly to the control cabinet by fiber-optics. Installers can wire field devices to the next I/O terminals in the nearest junction box.

Meanwhile, the control strategy is independently developed and tested by simulation using “virtualized hardware.” Once everything is brought together and hooked up, DICED technology would let the system automatically prepare for start-up, almost without human interaction. “It would just happen,” Vasser says.

The missing technologies are smarter I/O, virtualization for hardware and testing, the DICED capabilities, a third-party interface solution using Ethernet, standardized HMI, the IEC 61850 standard for communications in substations, and a suitable wireless system. I wasn’t the only one taking notes.

In other presentations, Chris Muench, C-Labs LLC (www.c-labs.com), said the IoT needs development to be used in manufacturing. “Industrial applications are different,” Muench says, “They’re not necessarily over the Internet, they can be device-to-device.” High speeds and determinism require transmission to be fast, so it can’t go through conversions. The cloud can provide outsourced computing power for analysis and historian functions, and the Internet can provide connections to supervisory functions through smart phones and tablets, but control must be local. Also, “Security must be baked in, not added on,” he says.

Herman Storey of Herman Storey Consulting talked about the ISA-108 standard for communication with intelligent devices, which would define how intelligent valves and transmitters should deliver self-diagnostics and other information to facilitate maintenance.

Our plants have a large HART installed base and some 67% of instruments are intelligent, but most are underused. ISA-108 intends to fill gaps between intelligent devices in automation systems and the ISO 55000 asset management standard used for everything else in the plant.

The ISA-108 initiative began in September 2012. So far, Storey says, the standards committee has drafted Part 1, Concepts and Terminology, and has “starting documents” for Part 2, Work Process Specifications, and Part 3, Implementation Guide. It’s a complicated job, and he offered no schedule for its completion.

As sensors and transmitters grow ever smarter and cheaper, data transmission and processing becomes secure and essentially unlimited, and the commercial space carpet-bombs us with innovative applications from trivial to awesomely inspiring. Opportunities abound for folks who can define and implement industrial versions, challenge traditional approaches, and build the missing links that offer a significant competitive edge for their plants and their companies.
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Lowering cost, increasing productivity, and shortening design times are just some of the challenges industrial engineers face. The graphical system design approach combines productive software and reconfigurable I/O (RIO) hardware to help you meet these challenges. This off-the-shelf platform, customizable to solve any control and monitoring application, integrates motion, vision, and I/O with a single software development environment to build complex industrial systems faster.

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February’s Web Hits

And the Winners Are...
The 2014 Readers’ Choice Awards. Each year, we ask our readers to identify the best solution providers in a broad array of process automation disciplines and technologies—from batch control to safety systems and wireless infrastructure to terminal blocks. Thanks to the participation of readers from across the process industries, this year’s awards represent the expressed brand preferences of nearly 1,000 automation professionals from all corners of the process industries. To check out the choices, go to http://bit.ly/OQveZ.A.

It’s All About the Operator
Process Automation Hall of Fame member William L. Hawkins generated a lot of buzz with his “The Operator’s Role in Process Automation.” He says, “Machines require operators because, despite marketing claims, there are no intelligent devices. The only intelligence exists in human brains,” and goes on to trace the operator’s job from the advent of the steam engine in the early 19th century to the problems and promises of his or her role today. This “Other Voices” column from our February issue is at http://bit.ly/lfABGsu.

The Lifetime Achievement Award Goes to...
The all-time most popular article on ControlGlobal.com is “The Beginner’s Guide to Differential Pressure Transmitters” by David Spitzer. He says, “The importance of level measurement can’t be overstated. Incorrect or inappropriate measurements can cause vessels to be higher or lower than their measured values. Vessels operating at incorrect intermediate levels can result in poor operating conditions and affect the accounting of material.” Read it at http://bit.ly/JEXaw0..

Big Fish Eat Smaller Fish
The Schneider buyout of Invensys has been big news. Our report on the finalization of the deal, found at http://bit.ly/1mXyg9G also garnered a lot of attention. At the announcement of the deal’s completion, Jean-Pascal Tricoire, chairman and CEO, Schneider Electric, said, “With Invensys, Schneider Electric will reinforce its industrial automation capabilities, boost its positions in key energy-intensive segments, and strengthen its software offering.”

The New Control System Integrator
Industry experts discuss how modern advances in information technology have changed the role of integrators today. http://bit.ly/1mXARAAY

Understanding NFPA-79
NFPA-79 is “intended to minimize the potential hazard of electrical shock and electrical fire hazards of industrial metalworking machine tools, wood-working machinery, plastics machinery and mass-produced equipment.” http://bit.ly/1eVbGbv

Building an HMI That Works
What’s wrong with most operator interfaces today, and how can they be improved? http://bit.ly/1dcvGK8

Smarter SCADA Alarming

What Are Harmonics and Why Should I Care?
Watch this video explaining harmonics and their implications in process control. http://bit.ly/1pQu1zg

How Often Should Instruments Be Calibrated?
This webinar discusses techniques for managing your calibration program effectively. http://bit.ly/1fTI5DH

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Better Signal-to-Noise Ratio Means Better Level Control Performance

While transmit pulse amplitude (signal size) has helped to make guided wave radar technology the standard for accurate, reliable level measurement, the fact is signal-to-noise ratio (SNR) represents a far more critical indicator of level control performance. For superior SNR in all process conditions, no other GWR device beats the Eclipse® Model 706 transmitter from Magnetrol®.

The ECLIPSE Model 706 transmitter has a signal-to-noise ratio nearly 3 times higher than competitors.

To learn more about the breakthrough ECLIPSE Model 706 GWR transmitter visit eclipse.magnetrol.com or contact your MAGNETROL representative today.
Is the 3 a.m., Sunday Morning Replacement the Killer App?

[Editor’s note: This comment is in response to our news of the new specification for Foundation fieldbus from our January issue at http://bit.ly/OQc9GY.]

Being able to replace a field device at the proverbial “3 a.m. on Sunday morning,” now also with a different version device, is a capability users have been seeking for a long time. A device can be replaced by a newer version without touching the control system—just like 4-20 mA. It’s good news for new and existing users of fieldbus that it’s now possible. That is, the DD file for the new device is not needed immediately; it can be downloaded and copied onto the system a few days later when the system administrator has time. Personally, I believe this is a major milestone for fieldbus. It makes fieldbus suitable for every plant, not just the energy majors like Shell, Chevron, Reliance, etc.

Learn more about device revision management and backwards compatibility in the device revision management guide found at http://bit.ly/1ohgEVf.

The NAMUR NE107-compliant device diagnostics alarms are great for putting device diagnostics to good use, integrating device diagnostics into work processes for daily maintenance and turnaround planning, etc., while at the same time avoiding alarm flooding. They’re at http://bit.ly/OQcQQq.

Guidance for how to incorporate NAMUR NE107 status flags into the process work is available at http://bit.ly/1ohh7ql.

It’s great that the Fieldbus Foundation has listened to the experience from existing fieldbus users like BP, Saudi Aramco, Petrobras and other leading energy majors, and incorporated their ideas into the technology, so that smaller users can also take advantage of modern digital technology all the way from the very “first meter,” and they can fully use digital systems from sensor to actuator to fully benefit from digital technology.

Existing users of fieldbus systems should upgrade to the latest version of system software to take advantage of the best available usability features to make it easier for the operations, as well as to run and maintain organizations to fully benefit from fieldbus advantages over conventional technology.

Pervasive Sensing

I enjoyed reading Ian Verhappen’s article on pervasive sensors (February 2014, http://bit.ly/1i4vOQf). Our vision of pervasive sensors encouraged us to find innovative ways to not just power sensors, but also communicate their data. FYI, we at OptiXtal (http://optixtat.com) have created a prototype of a battery-free, ambient-light-harvested device that detects temperature and presence and sends it wirelessly to a manager for action. See http://optixtal.com/optixtalwp.htm.

SAGAR VENKATESWARAN
PRESIDENT, OPTIXTAL

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SAGAR VENKATESWARAN
PRESIDENT, OPTIXTAL
In my teenage years, I was always fascinated to see that exactly when the church bell of my village started to ring, the herd of grey cattle always arrived in front of the little church where the farmers were waiting for them. It made no difference what the weather was like or how far from the village the cattle were grazing that day; they always made it exactly on time. The farmers were waiting there, discussing the news of the day, and took it for granted that the cattle would always arrive in time for the farmers to get back to their homes for milking, and after that, for dinner, where the goulash with lots of paprika had been slowly boiling all day and would just hit the spot, and finally get them ready for the pálinka and the storytelling after it.

How did this happen? What cascade control algorithm was used to adjust the speed and direction of several hundred animals, and what were the manipulated variables of this cascade loop? By the way, some say that these often one-ton animals were brought to Europe by Attila the Hun (Hungarian), providing his fighters with blood and milk—fuel for destroying the Roman Empire.

In any case, the slave controller of this selective PID loop was the herding dog called Bodri, member of the famous herding breed, the Hungarian puli, whose eyes are permanently hidden, and are believed by some to not even exist. (Other Hungarian breeds include the hunting vizsla and the herding komondor.)

Like a cattleman’s dog, a herding controller always goes after the variable that is furthest away. The cascade master of the loop was uncle János, the herdsman, who spoke to his horse and dog in single-word sentences. Based on these one-word setpoint adjustments, Bodri, the slave controller, applied his “herding PID algorithm,” and went after only one animal at a time, always the one that was furthest away from the desired direction or was the slowest.

I used this same algorithm on several jobs. I called it the “Puli Envelope” and later, because nobody knew what a puli was, changed it to “Envelope Optimization.” I used this control strategy when maximizing the heat efficiency of the IBM headquarters building at 590 Madison Avenue in New York. During the winter, I herded the heat from the interior offices to the perimeter by throttling one damper at a time (out of hundreds), always the one that was furthest away from the optimum.

I also used this “herding control” to optimize many combustion and boiler control systems. This was done by configuring a control envelope, such as the one shown in Figure 1, to control
Better Signal-to-Noise Ratio Means Better Level Control Performance

While transmit pulse amplitude (signal size) has helped to make guided wave radar technology the standard for accurate, reliable level measurement, the fact is signal-to-noise ratio (SNR) represents a far more critical indicator of level control performance. For superior SNR in all process conditions, no other GWR device beats the Eclipse® Model 706 transmitter from Magnetrol®.

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LESSONS LEARNED

several variables simultaneously by switching the control from one measurement to another, depending on which got closest to the border of the envelope.

For example, assuming that the boiler is on CO control, the microprocessor will drive the CO setpoint toward the maximum efficiency, but if in so doing, the opacity limit is reached, that will override the CO controller and prevent the opacity limit from being violated. Similarly, if the microprocessor-based envelope is configured for excess oxygen control, it will keep increasing the boiler efficiency by lowering excess O₂ until one of the envelope limits is reached. Then control is transferred to that constraint parameter (CO, HC, opacity, etc.), and through this transfer, the boiler is “herded” to stay within the envelope defined by these constraints. These limits are usually set to keep CO under 400 ppm, opacity below #2 Ringlemann, and HC and NOx below regulations.

Microprocessor-based envelope control systems can also include subroutines for correcting the CO readings for dilution effects or for responding to ambient humidity and temperature variations. As a result, these control systems tend to be both more accurate and faster in response than if control was based on a single variable. The performance levels of a gas-burning boiler under both excess O₂ and envelope control are shown in the lower part of Figure 1.

Envelope control also can be implemented by analog controllers configured in a selective manner (Figure 2). Here, each controller measures a variable and is set to keep that variable under (or over) some limit. The lowest the output signals is selected for controlling the air-fuel ratio by adjusting the combustion air flow, which ensures the controller most in need of help is selected for control. Through this herding technique, the boiler process is kept within its control envelope. Reset windup in the idle controllers is prevented by using external reset, which provides bumpless transfer from one controller to the next (Figure 2). Operator access is shown by a single auto/manual (A/M) station. A better solution is providing each controller with an A/M station. Then, if a measurement is lost, only the defective loop needs to be switched to manual, not the whole system.

I was reminded of this herding business by reading about the “tunnel controls” used in sending our robot to Mars, where this fast, missile-guiding process was stabilized (the vehicle was kept on course) not by forcing it to follow a single line (single setpoint), but allowing it to drift inside a control envelope, and making adjustments only if it reached the side of the control tunnel.

So, in a way, Bodri helped us to get to Mars, and on the other hand, we have reached the age when machines are starting to substitute not only for our muscles, but also for some of the routine functions of our brains.

THE PULI ALGORITHM AT WORK

Figure 1: Multivariable, envelope-based constraint control can minimize excess oxygen by monitoring some variables while performing constraint limit checks on excess oxygen, hydrocarbons, stack temperature and opacity.

AN ALTERNATIVE APPROACH

Figure 2. Analog controllers configured into a multiple selective loop also can be used to implement envelope control.
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Can Operators Hear the Fieldbus Music?

After your fieldbus project is installed and commissioned, and it’s time to start up the facility, how will it be different? Chances are, if we’ve done our job, no one should notice that the automation infrastructure is fieldbus; that is, the start-up should progress just as if it were a conventional facility. There will be some tuning of control loops required, just as with a conventional system. There will be some impulse lines that need to be purged, or a DP transmitter that needs to be zeroed at operating pressure—a little different for the technicians, perhaps, but from the point of view of operations, the same.

Start-up can be a tense time as licensors, process engineers and project managers anxiously await the verdict on their design and implementation. It’s the worst time for the measurement and control infrastructure to be any kind of distraction or sideshow. We want to be perfect, and when we are, they don’t even know we’re there, rather like the background music in a drama.

Consider the term HMI, or human-machine interface. What exactly are these machines with which our operators interface? They interact with our “machine” for sure—these days almost certainly a using a Windows box with some real-time graphics capabilities and connectivity to the other machines that constitute our DCS, including field devices. But the real operator interaction is with the process. I suppose you could say a hydrocracker or reformer is a machine, and such processes have plenty of machines such as compressors, pumps and valves routing process fluids through vessels and pipelines. But our operator’s ultimate interface is with a process, not a machine. If operators don’t manipulate the process to produce saleable product—hopefully making something more useful and valuable out of something less useful and valuable—then their mission is a failure. The more all the machines just do their job, the more effective the operator can be at keeping the plant safe, reliable and productive. A bit paradoxically, the controls specialist strives to deliver measurements and automation transparently, and stay out of the limelight.

Our profession supplies the process’ “nervous system,” if you will, providing most of the operator’s sense of its condition. They might hear a little fieldbus music playing when they wonder, “Did the control valve move when I asked it to?” Digitally integrated control valves report their position feedback in real time, and if you’ve taken pains to show this on your HMI (recommended), they can see nearly immediately; “I’ve clicked the up-arrow twice and nothing happened,” which in turn validates why a flow hasn’t changed.

More music might play for them when a flow exceeds its calibrated full scale, but keeps on indicating a valid flow, instead of saturating at 21.7 mA. They may not hear it at first, but fieldbus brings a whole distinctive layer of data validation. Every device plays a relentless refrain of “I’m here. I’m happy. I’m communicating, and my measured value Y (as a floating point value in engineering units) is valid at timestamp X ±1 millisecond.” An array of conditions that could indicate a measurement is questionable or “bad” are monitored and updated with similar rigor. Where fieldbus devices provide an interface to the process, each instance is imbued with a layer of diagnostics and intelligence designed to provide a more truthful and reliable version of reality and to instantly inform us when there’s a fault.

Operators may not seem to care much about the nuances of how our “machines” deliver information. But when they’re spending a tense 12 hours guiding the process through the straits of some challenge like extreme weather or an unanticipated feed change, relying on “one version of the truth” can mean the difference between safe harbors and following a siren-song into the rocks. Operators want to know their instruments aren’t lying to them. That’s the tune they like.
Feeding the Asset Management Beast

One of the challenges we as an industry now face is how to manage the data available from today’s integrated systems, and convert it to knowledge for action. I see the process of getting from data to action as requiring four levels of transformation: data (raw data collected from field sensors, operators, purchase orders, inventory levels, etc.),

- Status—One or more bits providing information on the present health of the device. In the process industries, this information is typically compliant with NAMUR NE-107, Self-Monitoring and Diagnosis of Field Devices.
- Diagnostics—Information on the health of the device, typically including, as a minimum, body temperature, program self-checks, etc., by which the device confirms that it’s operating within its design constraints and assigned/configured operating range.

Unfortunately, at least until the ISA-108 committee completes its work, I see a disconnect between automation asset management systems, which are good at taking the rich amount of data from smart field devices (more about them next month) and converting it to actions for an instrumentation technician or controls engineer, but not so good at linking to other maintenance systems to schedule support labor, such as scaffolders, pipefitters, millwrights, etc. Will the work underway at IEC on the digital factory and similar initiatives will help integrate all the disparate standards into a unified whole? Only time will tell.
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Hannover Fair Previews the Smart Factory

The fair, April 7-11 in Hannover, Germany, will highlight how intelligent, Internet-enabled devices will simplify and integrate future manufacturing.

The organizers of the world’s largest and most comprehensive manufacturing exhibition, Hannover Messe (www.hannovermesse.de), presented a preview of its upcoming 2014 edition on Feb. 11 at the Radialsystem V hall in Berlin.

The fair will be held April 7-11 in more than two dozen huge exhibition spaces in Hannover. The preview allowed members of the press to get an early look at some of the event’s major innovations and exhibitors.

The presentations all focused on the theme “Integrated Industry—Next Steps” and the specific steps needed to bring the Smart Factory concept to life using the integrated tools of Industry 4.0, which is being touted as a “fourth industrial revolution” driven by Internet-connected devices.

“When people ask me to describe Hannover Messe in a nutshell, I say it’s all about competitiveness,” said Deutsche Messe board member Dr. Jochen Koeckler. “It’s about people coming together to exchange ideas that will produce efficiencies, generate investments, and make them more competitive. These days, it’s no longer about big companies eating small companies; it’s about fast ones eating slow ones. However, to stay competitive, manufacturers need flexible, intelligent factories of the future in which machines, plant and products can talk to each other.”

More specific steps for achieving the fair’s Integrated Industry concept were presented by Prof. Dr.-ing. Detlef Zuehlke, scientific director for Innovative Factory Systems at the German Research Center for Artificial Intelligence (www.dfki.de), which has been developing its Smart Factory KL program since 2005. “Just as we have smart phones with data available anywhere and anytime, and we’re moving toward smart homes and smart cars, we’re also going to need smart factories,” said Zuehlke. “They’ll be more flexible and agile to handle more varied products, and have shortened production steps, such as quicker setup and retooling times and modular components that are easy to plug and play.”

Besides presenting full-scale models of how smart factories will operate, Hannover Messe’s exhibitors will show many Industry 4.0 tools that can be used to make applications and facilities smarter. For example, one Smart Factory demonstration will consist of a five-module production line for assembling business card boxes with secure RFID tags. The integrated line consists of a quality assurance section by Lapp Kabel, laser engraving section by Phoenix Contact and three assembly sections by Harting and Bosch Rexroth. Each section will have smart machine components to coordinate tasks with the others, network via TCP/IP, Wi-Fi and RJ45 protocols, and follow Han-modular standards for plug-and-play connectors.

Emerson Opens Third Innovation Center

Emerson Process Management (www.emersonprocess.com) has officially opened its new Emerson Innovation Center—Process Systems and Solutions in Round Rock, Texas. The 282,000-sq-ft, nearly $70-million facility will be the global headquarters for the company’s automation systems and project services business, which focuses on operations of facilities in industries such as oil and gas, refining, chemicals, power, life sciences, food and beverages, and metals and mining. The official opening included comments by Texas Governor Rick Perry and Dell Inc. CEO Michael Dell.
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IN PROCESS

The event included unveiling of a new Integrated Operations (iOps) Center and announcement of an Integrated Operations Initiative to addresses customers’ needs for streamlined decision-making, easily accessible expertise and the safe, collaborative co-location of essential personnel.

Comparing an automated manufacturing facility to the human body, with sensors and transmitters providing sensory data, the controller as the brain, and valves/actuators/drives as the muscles, “In Austin, we focus on the brain, the DeltaV controller,” said Jim Nyquist, president, systems and solutions business, Emerson Process Management.

This Innovation Center is the company’s third. The first, in Marshalltown, Iowa, develops and tests flow control applications and technologies, and a second in Pune, India, focuses on software application development. The Emerson Innovation Center in Austin brings several world-class disciplines under one roof:
• A technology and product design and support center, providing engineering and development for the DeltaV digital automation system and DeltaV SIS Safety System;
• The Integrated Operations (iOps)

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David Farr, Rick Perry, Michael Dell and Jim Nyquist cut the ceremonial ribbon on Emerson Process Management’s new Innovation Center in Round Rock, Texas.
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• The company’s Project Management Office (PMO) which aligns and integrates the company’s best practices, processes, systems and metrics for global project execution.

**Polk Opens Advanced Training Center**

Polk State College (www.polk.edu) celebrates the opening of a 47,000 sq-ft Clear Springs Advanced Technology Center just east of Bartow, Fla. Through the donations of Endress+Hauser (www.us.endress.com), Rockwell Automation (www.rockwellautomation.com) and TriNova (http://www.trinovaine.com/), Polk State College will be the new home to a $1 million, state-of-the-art PTU (Process Training Unit). The PTU is outfitted to help students and customers gain hands-on experience with the types of operation, diagnostics and troubleshooting found in real-life process plants. It

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features the latest Endress+Hauser flow, level, temperature, pressure and analytical instrumentation in addition to the PlantPAx process control system donated by Rockwell Automation. The PlantPAx process automation system will be used in a functioning environment with field devices to train customers for operation and maintenance of process systems. In addition, it provides a venue for demonstrations of Endress+Hauser and Rockwell Automation technology and a regional resource for customers to obtain hands-on training in a controlled environment. TriNova will conduct workforce training courses at the facility in order to help companies in the region.

**CLPA Adds Energy Management to CC-Link IE**

The CC-Link Partner Association (CLPA, www.cclinkamerica.org) has added energy management functions to CC-Link IE, the open automation network technology, to create CC Link IE Energy, a combined energy and production management control system. The new CC-Link IE Energy capabilities allow production managers to easily monitor energy consumption by individual machines or processes over the same networks they already use for general control purposes.

CC-Link IE is a high-performance, gigabit Industrial Ethernet open network technology that handles both control and information data at high speed to provide efficient integrated factory and process automation. With the addition of energy management functions, CC-Link IE Energy provides real-time monitoring of a plant’s many energy-consuming devices, ensuring energy optimization of each device.

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Control’s Monthly Resource Guide

Every month, Control’s editors take a specific product area, collect all the latest, significant tools we can find, and present them here to make your job easier. If you know of any tools and resources we didn’t include, send them to ControlMagazine@Putman.net with “Resource” in the subject line, and we’ll add them to the website.

OPEN- AND CLOSED-LOOP SYSTEMS
The basics of open- and closed-loop systems are outlined in these two tutorials. Both systems are defined, and each tutorial is accompanied by diagrams and equations illustrating the basic points. Feed-forward and open-loop motor control are discussed at http://bit.ly/1fOgtMY. Closed-loop control, including feedback systems, summing points, transfer functions and the advantages and disadvantages of closed-loop systems are covered at http://bit.ly/1hWRl0.

PID LOOP TUNING, THE MOVIE
These two roughly six-minute videos explain both proportional and proportional-integral loop tuning using as a model an HVAC system for an ICU burn unit, where temperature and humidity control are essential. Each link also contains a brief write-up explaining the basic principals illustrated. The direct link to Part I is at http://bit.ly/1fjuEbB. Part II is at http://bit.ly/1ec8mwF.

WHAT IS PID ANYWAY?
Understanding the concept of PID is basic to mastering loop control theory. This brief tutorial outlines the basics of PID, including definitions, drawings, equations and fundamental theory. The direct link is at http://bit.ly/1msNUJZ.

CONTROLLER LOOP-TUNING BLOG
The Control Notes blog from the Opti-Controls website covers a variety of tuning subjects, including cascade control, the Ziegler-Nichols closed-loop tuning method, a PID controller algorithm, level control loops, derivative control, drum level control, control loop performance monitoring, typical controller settings, steam temperature control, causes of dead time and Lambda tuning rules. The direct link to the blog is at http://blog.opticontrols.com/.

PLC LOOP CONTROL LIBRARY
This web page contains links to a number of tutorials, including “Observing and Analyzing Process Data,” “High and Low Output Select Logic,” “Collecting Data for Controller Tuning” and “Error Squared Controllers.” It also has a brief bibliography of process control books and links to other tutorials and sites with more loop tuning information. The direct link is at http://bit.ly/1Ky6Hm0.

INTRODUCTION TO CONTROL
This tutorial is part of a larger one that covers basic control theory. The chapter on control loops and dynamics covers open- and closed-loop systems, single- and multi-loop control, cascade control, process dynamics and more. The direct link is http://bit.ly/1hrzKaU.
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Enhancing operator performance means tailoring the right combination of situation-aware displays, rationalized alarms, ergonomic consoles and field-capable interfaces. Here’s how users maintain operator effectiveness.

by Jim Montague

Ever since people first started using labor-saving tools, they’ve gladly accepted whatever occupational difficulties and hazards that came with them. Just as getting blisters from digging with a shovel is still way better than scratching the earth with bare hands, operating today’s huge mining shovels and trucks or running deep-sea oil drilling, extraction and distribution facilities is better than each of the old methods they replaced. Who cares if the control room is cramped, poorly lit and spits out cascades of nuisance alarms? It’s still better than what went before, right?

Too true, but the eternally innovative spirit that inspired all these great tools, automation and controls in the first place is never completely comfortable or satisfied because it never really switches off. That’s why engineers are always trying to find new and better solutions, and why formerly separate methods of improving operator performance in process control continue to be perfected, but also are starting to merge into a unified whole that’s tailor-made to better suit the needs of each user and application.

For instance, training is getting out of the classroom to include more realistic simulations; SCADA software and HMIs are using situation-awareness principles and alarm rationalization to build more effective displays; consoles and control rooms are improving ergonomics and even adding balance and aerobics; and field-based interfaces are adding more network pathways and Internet links, as well as tablet PCs, smart phones and wearable components. Bring your own device (BYOD) seems to be going on everywhere, and this presents a bunch of new opportunities and new problems to solve.

New Applications, Better Education

Because so many process applications are retooling or adding units to handle new or more varied products, even veteran operators are finding they need some added training along with the rookies. However, everyone is learning their instruction can come in some new, unexpected, multimedia forms and use more real-life input.
For example, China National Petroleum Corp.’s (www.cnpc.com) 40-year-old Qingyang Petrochemical Co. recently added an oil refining facility that can process 3 million tons of products per year, and it implemented ABB’s (www.abb.com) Freelance DCS, which consists of 19 pairs of redundant AC 800F controllers to manage 12 processes and auxiliary systems with approximately 10,000 I/O points. This DCS also includes four engineering stations and 32 operator stations with intuitive interfaces, networking via 100-Mbps, fiber-optic Ethernet, and communications via Profibus PA/DP, HART, Foundation fieldbus and Modbus protocols. It uses redundant process control stations, network connections and power supplies to ensure safe production.

However, because this was a new refinery and many of Qingyang’s operators were unfamiliar with their new equipment, ABB also provided its operator training system (OTS) as part of its project delivery, so the staff could quickly learn their new systems and equipment, avoid errors and achieve steady operations. Based on Qingyang’s individual requirements, ABB didn’t stop with the OTS and also extended Freelance’s standard soft controller functions and added customized functions and corresponding interface software.

**Reinforcing Awareness**

Besides using training devices linked to actual controller tasks and data for better instruction, operators also are benefiting from improved displays and greater use of situation-awareness recommendations and strategies. However, even though many higher-resolution displays and support tools are available, sometimes operators need to make a cultural change before they can really begin to embrace and use them, says Jason Wright, Plant PAx system marketing manager at Rockwell Automation (www.rockwellautomation.com). “Many operators tell us they want their new displays to look just like their old ones, which means their user experience and effectiveness won’t improve. So we’re trying to convince users to apply some new HMI strategies by presenting them as a workforce solution and implementing them with the least impact to existing systems. This is why our recent Plant PAx Sequencer 3.0 release has display elements and a library that are much easier to program and deploy. They also show performance targets, operating ranges and histories, which give operators better context and intelligence. And these elements also remain in synch over time, so they’re easier to track in the future, which also aids acceptance.”

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**Figure 1:** Gail Gas Ltd.’s main master station and back-up master station use Yokogawa Fast/Tools SCADA software, high-availability computers, and history, client and zonal servers in a triple-redundant configuration to ensure 24/7 access to data from regional gas management centers running seven natural gas pipeline networks across India.
Roy Tanner, ABB’s 800xA product marketing manager, adds that, “More people are catching on to the value of using high-performance graphics and situation-awareness tactics. Luckily, where only big oil and gas, chemical and power companies used to be able to afford high-performance graphics and address situation awareness, these days even small water utilities and other small companies can use them and gain better situation awareness, too.”

Stan Devries, senior director of software solutions architectures at Invensys Operations Management (http://iom.invensys.com), which is becoming part of Schneider Electric (www.schneider-electric.com), explains, “We need to rethink training to include in-class, on-the-job and regular refreshers, instead of the usual training for a new project before start-up, and then neglecting it later. We’ve found cases where it took eight years of traditional training for operators to reach error-free status, but using established metrics could reduce that time to 1.5 years. This training is also important in pulp and paper, refining and other industries where operators can go seven years between shutdowns and overhauls, so many operators have never started their application up from zero.

“Effective training based on best practices is also crucial because more operators are becoming at least partially responsible for business performance, so they’re trying to declutter their displays. This means focusing on quality alarms and grade-change alerts, but operators also want to know at the console about broader situations that their applications are in. They also want quick look-backs at previous batches to help show next steps, assist situation awareness, and avoid undesired situations or make the most of good situations.”

To help these efforts, Invensys maintains a Situation Awareness Library that works in conjunction with its new Foxboro Evo process control platform and Wonderware InTouch software. The library’s polar plots, spider charts and other indicators also are combined with Invensys’ Dynamic Performance Measures consulting service, which takes a process unit’s existing economic, quality and efficiency measures, then develops new targets and measures operators can use to make better decisions.

“The library works with our new InTouch 2014 software and Wonderware System Platform 2014, and gives operators a better context for their information instead of just showing them values, which they report is allowing them to find significant issues about 40% faster,” says John Krawjewski, Invensys’ product management director for HMI and supervisory control products.

Organize, Supervise, Optimize

Of course, one of the best ways to improve operator—and manager—performance is to provide an overall view of the entire facility and its processes before drilling down to individual applications or equipment. These big pictures remind users of the full scope of their responsibilities, especially at shift changes, and helps put subsystems and individual applications into a more understandable context, particularly in relation to their upstream and downstream processes.

For instance, India’s state-owned Gail Gas Ltd. (www.gailgas.com) in New Delhi includes all aspects of the natural gas supply process from exploration and production to distribution and customer service. It operates two major liquefied petroleum gas (LPG) pipelines, Jamnagar Loni and Vizag Secundrabad, which move gas to bottling plants, and it runs seven natural gas pipelines across India with a total length of more than 10,700 kilometers.

Previously, Gail’s operators used telephones to manually collect operations data for each regional pipeline. However, because its operators and administrators were having increasing problems managing so many different SCADA systems for their LPG and natural pipelines, Gail recently decided to install one centralized SCADA system for all of them, and integrate it with all future pipelines that were either under construction or planned.

After investigating several solutions, Gail selected Fast/Tools SCADA software from Yokogawa Electric Corp. (www.yokogawa.com), which also designed and implemented a system architecture suited to Gail’s existing pipeline network.

Continued on page 37

Figure 2: Following a year of studying operators in their control rooms, Honeywell’s Experion Orion console and collaboration station incorporated a more ergonomic design, larger and more flexible display surface, pan and zoom navigation, and ambient alarm lighting.
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and able to integrate with its expansion requirements. Consequently, Gail and Yokogawa replaced the pipelines’ former networks and equipment, installed their new, unified SCADA system and integrated many types of remote terminal units (RTUs) and hundreds of individual devices in just 15 months, ending in July 2012.

The new SCADA system is in a main master station (MMS) that houses all of Gail’s primary SCADA servers, which are located at the National Gas Management Center (NGMC) in Noida. This system was also installed at a hot back-up master station (BMS) in Jaipur in case of a disaster. Along with implementing Fast/Tools, Yokogawa installed a high-availability computing (HAC) solution that uses history, client and zonal servers in a triple-redundant configuration (Figure 1). From their terminals in the central control room, operators can view operations data 24/7 for all of their regional pipelines.

Each regional gas management center (RGMC) also has a Fast/Tools-based HAC that uses dual-redundant, front-end processor (FEP) servers for continual monitoring and control. Thanks to this redundant design, operations and maintenance data from the field also is uninterrupted, and operators, production engineers and analysts at the NGMC have real-time, visual access to information needed to run their nationwide network. In fact, Gail reports system availability for its entire pipeline network has increased to 99.5%, which ensures a steady supply of gas across India.

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Redefining Flow Control
In addition, all of Gail’s pipeline networks have been integrated with a gas management system (GMS), so operations data can be used directly for gas allocation and billing. Email and short message service (SMS) notification of critical alarms are supported, which allows authorized personnel to access the new SCADA system from anywhere with an Internet connection.

“This is the largest SCADA system ever commissioned by Gail,” says S.K. Agrawal, Gail’s deputy general manager. “Work on our new SCADA system included integration of approximately 400 RTUs of eight different makes. Besides improving operations and maintenance, centralized SCADA has substantially reduced our capital expenditures and operational expenditures. All the new pipelines coming up in the next 10 years will be integrated with this SCADA system.”

Right in Front of Your Face
Because humans take in more than 90% of their information about the world through their eyes, the most crucial devices for improving operator effectiveness are still HMI displays and screens. Fortunately, black-background, cluttered and overly colorful screens have been giving way to simpler, less distracting displays with prioritized colors and concentration on the most important data values and alerts. These improvements are largely thanks to the work of the Abnormal Situation Management Consortium (www.asmconsortium.net), Center for Operator Performance (www.operatorperformance.org) and PAS Inc. (www.pas.com). Many suppliers are following these recommendations for situation awareness, hosting displays on higher-resolution screens, and even offering HMIs that are large enough for several operators to work together when needed.

Stewart Andrew, product manager for Honeywell Process Solutions’ (www.honeywellprocess.com) Experion Process Knowledge System (PKS) HMIs, reports his firm just spent about a year observing and working with operators as part of its Operator of the Future Initiative to find the most effective and ergonomic conditions for them to work in, and redesigned its consoles as a result. The latest Experion Orion console and collaboration station will be released in mid-2014 (Figure 2).

“A key change in our console is that, where we used to have multiple small
screens, Experion Orion will now have one, large, 50-inch, continuous work surface,” says Andrew. “This will allow operators to lay out, display and combine information in front of them in the most effective way for each application. Operators will no longer have to rotate between different screens when checking overviews, alarms, etc. Some operators also reported that using Windows and a mouse wasn’t as quick and responsive as their former touchscreens and touchpads, so the new Orion will also have a touchpad component.”

Likewise, Tanner adds ABB recently launched its 800xA Collaboration Table, which allows several users to examine an application and KPIs at once. It also uses some 3D visualization gained from gaming technology to illustrate those KPIs. “This could be especially useful to shift supervisors as they go through their day or when making sure everyone is on the same page at shift changes,” adds Tanner.

Besides size, resolution and comprehensive indicators, operators also want the same manipulation capabilities they have on their smart phones and tablet PCs. “Users want the same multi-touch, pinch-and-zoom and sweeping features on their display screens that they have on their smart phones,” says Jeff Payne, automation controls product manager at AutomationDirect (www.automationdirect.com). “That’s one reason why we developed and launched our Point of View HMI/SCADA software about six months ago. It has drivers for many PLC families, uses many thin-client functions to give users greater access to their data, can be accessed via mobile clients or web browsers, and is able to scale onto any tablet PC or smartphone.”

Of course, this mobility means more interfaces are making their way out into the field, but some operators are even trying to take more experienced eyeballs along with them. To aid this impulse, XOEye Technologies (www.xoeye.com) makes eyeglasses with a 5-megapixel camera, LED lights and audio speakers, which enables an operator to show colleagues back in the control room exactly what he’s seeing in the field.

Rationalize, Record, Recreate
One of the most important ways to improve the performance of process control operators is to rationalize the streams of nuisance alarms produced by many applications, but deciding on which alarms are significant and
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required action and which aren’t im-
portant and can be safely ignored is
typically a complex, lengthy and labor-
intensive process. These projects are
worthwhile, but they usually require a
dedicated team of engineers, so many
small organizations can’t afford them.
“One of InTouch’s new features is
Alarm Aggregator that allows users to
place information about alarms into
metadata areas. It then generates alarm
counts, shows where they’re occurring
and on what devices, reduces them to
four levels of severity, and shows only
critical alarms in red,” says Invensys’
Krawjewski. “This means anyone, re-
gardless of their skill level, can use
these tools.”
Andrew Brodie, Fast/Tools market-
ing manager in Yokogawa’s control
instruments division, adds that Fast/
Tools’ Alarm System Performance
Analysis (ASPA) option can assist oper-
ators by evaluating alarms in its Alarm
Master database, determine which are
bad actors, and help users analyze their
existing applications more deeply by
comparing performance before and af-
ter changes are made.
“Operators can add a chronological
date range, point it at their alarm da-
tabase, and ASPA will work with Yok-
ogawa’s historian, which is proficient at
gathering alarm data and identifying
alarm trends,” explains Brodie. “For
smaller facilities, we also do alarm ra-
tionalizations as part of our Advanced
Decision Support service. We help
benchmark current situations, develop
an alarm philosophy document, and
help phase in an improvement plan.”
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Decision Support service. We help
benchmark current situations, develop
an alarm philosophy document, and
help phase in an improvement plan.”
Brodie adds that Fast/Tools V.10 was
just released, and it has an event-based re-
cording tool that can document all moves
and mouse clicks in an application, find
out what’s been done wrong or right
Continued on page 44
What was less surprising was the fact that the IceStation - along with the computer and monitor inside it remained completely unharmed. All ITSENCLOSURES are constructed out of 14-gauge steel and built to last forever and a day. Should one of our enclosures ever actually fail due to manufacturer defect, we will replace it as fast as humanly possible so your business does not skip a beat. Built to meet NEMA 12 standards, IceStation TITAN protects computer systems from harmful dust, dirt, and splashing fluids. With a large viewing window designed to accommodate up to 24” wide screen monitors, a retractable keyboard drawer, oversized work surface, and a track record of 29 years of experience protecting electronics, ITSENCLOSURES is the one name you can trust. To learn more about IceStation TITAN, call 1.800.423.9911 or visit ITSENCLOSURES.com.

TRUE STORY

When an overhead crane accidentally dropped a steel pipe 15 feet onto an IceStation, workers were relieved to find the pipe had not been damaged.
OPERATOR PERFORMANCE

Continued from page 42
during a certain period, and retain targeted recordings of golden batch episodes that can be used later for training. Looking outside the process, Fast/Tools also has a Collaboration Decision Support Center, which aggregates and displays data sources external to the application but still relevant to it (Figure 3).

Rise and Walk
Beyond being mobile in the field, some developers are encouraging operators to be more mobile and active at their desks in the control room. Some facilities have exercise equipment next to their control rooms, and some developers are making consoles, desks and chairs that allow operators to stand as well as sit while they’re working. Honeywell’s Andrew adds, “Control room operators are still working many 12-hour shifts, but their roles are changing from manipulating and optimizing processes to hitting economic targets, and this can add a lot of stress. As a result, ergonomic designs are adding sit/stand modes to many workstations, so operators can avoid the health dangers of sitting all the time.”

For instance, Connexus Energy Group (www.connexusenergy.com) is a customer-owned energy cooperative in Ramsey, Minn., that serves 126,000 members in seven counties north of the Twin Cities. Its operations control center recently needed new consoles as part of an upgrade to a new SCADA system to improve communications with its substations and reduce response time to outages.

Besides enabling all communications functions at each console so operators wouldn’t have jump from station to station, Connexus also wanted adjustable-height consoles to fit its differently sized operators and reduce their neck and back aches from craning to see stacked-up monitors. So the utility adopted Ascend Sit/Stand consoles from Winsted Corp. (www.winstead.com), which allow Connexus’ operators to raise and lower their workstations to whatever level is most comfortable (Figure 4).

“What we didn’t anticipate is that operators are leaving their consoles in the stand position as the default,” says Nick Loehlein, Connexus’ systems operations leader. “We’d assumed the standing position would be the exception rather than the rule, but they’re standing during their night shifts. If they want to sit, they take a tall chair and maybe sit for a half an hour, and then they stand right back up again.”

Smart Everywhere
Because so many operators, engineers and managers are practicing BYOD in their facilities, many suppliers are scrambling to offer apps for the flood of smart phones and tablet PCs coming onto some plant floors. Most of these apps are enabled by the HTML 5 standard that allows their graphics to scale up or down, and fit on different-sized displays.

Mario Mitchell, electronics product manager at Parker Hannifin Corp. (www.parker.com), reports his company recently launched iOS and Android versions of its Remote Manager app, which can control its Factory Display and Express HMI software. “With just an IP address and a password, operators and managers can view their operations and control processes, see critical information and alarms, and even turn devices on and off.”

While its InTouch Access Anywhere software also uses HTML 5 to show all indicators and controls on any device with a web browser.

Tanner reports that ABB is beginning to explore eye-tracking technology and augmented reality tools to further enhance its interfaces. He adds its augmented reality efforts, such as overlays for displaying temperatures, trends and alarms, can be examined by looking up the 800xA symbol at the Apple iTunes Store (www.apple.com/itunes). ■

FOUR PILLARS OF OPERATOR EFFECTIVENESS

In its “Set Your Operators Up for Success” supplement to the May 2012 issue of Control, ABB (www.abb.com) explains there are four cornerstones to help operators achieve their potential despite increasingly complex applications. They share a philosophical shift that evaluates each operator’s needs, abilities and limitations, and puts them at the front of the design process. These four pillars are:

• Plant system integration: Raw data and other inputs must be transformed into actionable information in a context that’s easily viewed, listened to or sensed in an integrated environment regardless of source. The challenge is to provide seamless access to multiple sources of information, but at the same time not overload operators with irrelevant data.

• High-performance HMIs: User interfaces must be intuitive and allow operators to manage views dynamically. A high-performance interface supports situation awareness through how information is displayed, as well as abnormal situation handling through advanced filtering and consolidation strategies.

• Human factors and ergonomics: Just as manufacturing processes are designed to be carefully controlled and manipulated to achieve desired outcomes, high-performance control rooms and operator stations must be designed from the beginning with operator performance in mind.

• Integrated simulation environments: High-fidelity simulator training ensures operator competence and instills confidence, especially in situations seldom encountered in routine operations. Integrated simulation environments leverage graphics and logic developed for the control system itself, providing a more realistic and more easily maintained simulation environment.
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From Reactive and Preventive to Condition-Based Predictive

The 25-year transformation of maintenance and repair to asset management.

by Paul Studebaker

When Control magazine launched in 1988, process instrumentation and control systems had little to contribute to their own maintenance and calibration, much less the condition of process or auxiliary equipment. Back then, savvy plants performed preventive maintenance, overhauling equipment and calibrating instrumentation on regular schedules during annual—or more frequent—shutdowns. Day-to-day problems were spotted, diagnosed and corrected by experienced operators, engineers and technicians on the fly.

By 1991, we were writing about separate systems dedicated to monitoring turbines, pumps and compressors, mainly by detecting unusual vibration levels. At the time, these expensive systems were justifiable for only the most critical and costly equipment.

In the recession of the early 1990s, engineering and maintenance staffs were reduced and, in many cases, ultimately replaced by outsourcing and automated systems.

Continued on page 49
Top 10 Trends, Number Six: Asset Management Displaces ERP

“In the battle of TLA du jour (three-letter acronym of the day), enterprise asset management (EAM) seems to have overtaken enterprise resource planning (ERP),” says Rich Merritt, technical editor. “Though EAM appears to be whatever the marketers say it is, it most definitely is the NBT (next big thing) in process control.”

On the Horizon

Fueled by more process data, better plant information and critical decision-making capabilities, 2003’s top technology trends included number 6: “Condition Monitoring Goes Comprehensive.”

Hat’s On for Process Control

Civil engineers at the University of Illinois have combined a hard hat with a camcorder, tape recorder, digital camera and electronic notepad. “The compact unit weighs approximately five pounds.”

Asset Management Meets Smart Field Devices

An asset management system at Lenzing AG’s new Lyocell fiber plant in Austria comes “close to full utilization of the massive amounts of information generated by smart instruments throughout the plant.”

When Times Are Tough, the Tough Look to Asset Management

Total enterprise asset management (TEAM) applies predictive condition monitoring to the plant and throughout the enterprise through remote connectivity, but you don’t have to have it all to find fast paybacks.

Risk Analysis to Benefit from Shared Reliability Data

The American Institute of Chemical Engineers’ Center for Chemical Process Safety has launched the Equipment Reliability Database Project to collect and share real-world experiences, starting with valves, heat exchangers and pumps.

Eastman Chemical Tests Pump and Motor Condition Monitoring System

The company’s Kingsport, Tenn., plant moves from preventive to predictive maintenance with the IQ PreAlert system recently introduced by Rockwell Automation/Reliance Electric.

Asset Management Hits the High Seas

Moving to PLC control of its main propulsion and power generation equipment allows the latest vessel in the U.S. Navy’s Smartship program to move from preventive to condition-based predictive maintenance.

Artificial Intelligence Expands Frontiers in Asset Management

“Asset management has evolved as a higher function of process control,” says Bob Waterbury, senior editor. “It incorporates elements of control with predictive modeling—and more recently with artificial intelligence—to better manage plant operation and maintenance.”

The Art of Troubleshooting

From setting traps to circling wagons, William Mostia, PE, describes 13 methods for solving difficult instrumentation and control problems.
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**MAY2005**

Predictive Maintenance to the Rescue!
As the maintenance skills shortage crisis continues to brew, process control vendors are jumping in with vibration analysis, condition monitoring, equipment diagnostics and predictive maintenance.

**JUNE2003**

Center on Reliability
Forget preventive maintenance—today’s uptime requirements call for an entirely different approach.

**MARCH2004**

Linking Asset and Maintenance Management Systems
“The easiest integration occurs when linking software programs from the same vendor,” said Dan Hebert, technical editor. Second best is to stay within a framework like IndustrialIT from ABB, ArchestrA from Invensys and FactoryTalk from Rockwell Automation.

**MAY2006**

Machines Staying Healthy by Getting Smarter
Executive editor Jim Montague describes how machine health monitoring is going beyond mainstream vibration and oil analysis by applying high-resolution sensing and prioritized data processing technologies to process as well as machine data.

**MARCH2008**

Pulling Together on Asset Management?
New preventive maintenance, condition-based and optimization tools and techniques are making asset management pay off—if you can get your maintenance people to use them.

**SEPTEMBER2009**

Emerson Announces AMS Suite: Asset Portal 4.0, Powered by Meridium

**JANUARY2010**

Honeywell Acquires Rights to Shell’s Operator Rounds Technology

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The Art of Asset Management
Most companies have accepted the value of asset management, especially in North American brownfield plants, where the only two ways to compete with greenfield competition from overseas are process optimization and asset management.

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GE Proficy Maintenance Gateway Closes Loop between Production and Maintenance

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Emerson and Beamex Ally to Integrate Asset Management and Calibration

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Emerson and Beamex Ally to Integrate Asset Management and Calibration

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Honeywell Acquires Rights to Shell’s Operator Rounds Technology
a trend that has accelerated ever since, as the knowledge to maintain increasingly complex control systems has become more specialized, rare and costly, while the prices of automation sensors and information technology continue to fall.

Smart Instruments Enable Self-Diagnostics
In 1996, William Mostia, PE, wrote that, “Most modern microprocessor-based equipment has some ability to provide self-diagnostics. More and more equipment is falling into this category, and with the advent of digital communications and coming fieldbus technology, built-in diagnostics should only get better.”

Instrumentation became smarter, HART and digital fieldbuses gained ground, and more companies adopted the computerized maintenance management systems (CMMS) that grew up to be today’s enterprise asset management (EAM) systems. The issues evolved from not having enough data to not being able to use it effectively, in part because instrumentation and control asset management software (AMS) has been difficult to integrate with EAM systems.

In March, 2004, we wrote, “It’s often helpful to augment the CMMS with asset management software (AMS). Asset management can include everything from relatively simple software that gathers instrument data to highly sophisticated programs that analyze data, predict failures, and direct preventive maintenance.

“When it is time to link a CMMS to an asset management application, there are a wealth of options ranging from manual data entry to fully automated data transfers. Although all vendors presently strive to provide standard protocols for integration among different software programs, the easiest integration occurs when linking software programs from the same vendor.

“Second best, in terms of ease of use, is linking software programs developed under the same framework. Most all CMMS and asset management software runs under Windows, but vendors are now creating a layer above Windows called a framework.”

We reported on frameworks in detail in our Jan. 2003 issue. Some of the products in this category are IndustrialIT from ABB, ArchestrA from Invensys and FactoryTalk from Rockwell Automation.
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OPC Tries to Set Us Free

In March, 2009, we said OPC has made it practical for plants to take on the integration themselves. "Five years ago, I'd have said no," said Peter Martin, vice president of strategic ventures at Invensys. "However, connectivity today is better than ever. With OPC, ISA-95, MIMOSA and the OpenO&M standards, packages that comply can go together much more easily. In fact, Invensys often uses AM packages from other vendors."

As the accompanying timeline indicates, this was a time when automation, CMMS and AMS vendors allied with and/or acquired companies to build their asset management capabilities.

By November 2011, we were routinely reporting detailed success stories of companies reducing automation and plant operating and lifecycle costs with effective asset management. "New pressures both from the market and from regulators to save energy, be more environmentally sensitive and be ‘green’ and ‘sustainable’ are pushing maintenance into a more positive light," wrote managing editor Nancy Bartels. "A well-run maintenance department with a clear focus on energy efficiency can be key to both sustainability efforts and clear, bottom-line savings. Who knew?"

But taking full advantage of automation and control as a plant “nervous system” that we can readily tap for instrumentation and equipment condition information we can use to optimize operations and maintenance is still an elusive goal. That’s the objective of the ISA108 Intelligent Device Management standards initiative, formed in September 2012 to define standard templates of best practices and work processes for design, development, installation and use of diagnostic and other information provided by intelligent field devices.

Commercial Technology to the Rescue?

Today, cloud-based systems are giving equipment vendors and service providers remote access to condition information, so they can provide monitoring and analysis for a fee. The cloud also easily supports software-as-a-service (SaaS) applications.

"It turns out that SaaS has found a home in the process industries, namely for remote access," we wrote in November 2013. A supplier can create a cloud-based application that can communicate to various types of hardware and software platforms such as RTUs, PLCs and operator interface terminals installed at remote sites. The application can also communicate to remote-access hardware, including smart phones and tablets, PC-based HMI platforms and databases.

"Using this information, remote support engineers can proactively contact customers, and begin working on issues before downtime events occur," said Anil Gokhale, PE, global manager, process and process safety technology for the systems and solutions business at Rockwell Automation. "When an event does occur, having access to historical information greatly reduces the time spent troubleshooting, and significantly decreases downtime duration. As we connect to more equipment and collect more data, we can develop additional algorithms and logic to do more predictive analysis to improve asset performance and uptime."

Going forward, we see relentless development of commercial applications based on the burgeoning “Internet of Things (IoT).” This technology is inspiring and empowering automation and software vendors, control engineers, equipment makers and maintenance managers to devise and implement sensors and systems to help them pare operating costs and prevent downtime. As the costs of sensors, bandwidth, communications and computing power continue to fall, this “pervasive sensing” approach has become a most interesting trend in maintenance and asset management.
Valves Get Better
Bells and Whistles

Process control valves are adding new, sophisticated and intelligent electronics, networking and other innovations. Here’s how users are applying them for maximum benefit.

by Jim Montague

From ball screws to butterflies, valves are some of the hardest working and most reliable members of the process control and automation community. And just like those other components, many types of valves have been getting some serious technical makeovers in recent years—to the point that users often don’t know about the helpful skills they’ve acquired.

However, some users are well aware of recent innovations in several primary valve technologies because they rely on them every day. For instance, Ineos Chlor (www.ineos.com) is a major European producer of chlor-alkali and chlorine derivatives, and it recently reduced process variability by 5% at its plant in Runcorn, U.K., by replacing four traditional butterfly valves with Fisher Control-Disk valves from Emerson Process Management (www.emersonprocess.com). This reduced variability, enabled the plant to increase throughput, avoid several unplanned shutdowns that could have cost a total of $600,000, and achieve a 96% overall equipment effectiveness (OEE) rating for the unit where the valves were installed (Figure 1).

“In a plant this size, even a modest reduction in variability can have a significant payback,” explains Barry Makepeace, Ineos Chlor’s control and instrumentation engineer. “Applying the Control-Disk valve not only saved us money, but also enabled us to optimize process control without sacrificing flow capacity or needing to re-pipe.”

Runcorn previously used its butterfly valves to control the temperature and flow of cooling water to its primary condensers. Tight control is essential because if the condensers’ temperature is too low, there will be residual chlorine in the system, which has to be removed. If the temperature is too high, there’s an increased risk of a safety trip or plant shutdown. Each trip and subsequent unplanned shutdown can cost up to $100,000.

Unfortunately, the older valves had a small control range and a large dead band, which reduced their response to temperature changes. In the 12 months before replacing its valves, the plant experienced 23 trips and big production losses. However, adopting the Control-Disk valves provided a control range of 15 to 70% of travel, approaching the range of a segmented ball valve. This tighter, more reliable valve control enabled Runcorn’s operators to optimize temperature set points and avoid at least six unplanned shutdowns.

Tank Farm Retrofit in Turkey

One of the most useful ways that recent valve innovations can be applied is in helping older systems gain a new lease on life. For example, the Tupras Izmit refinery in Kocael province, Turkey, recently undertook a major modernization program that included retrofitting more than 900 valves at the refinery’s tank
farms with Rotork’s (www.rotork.com) valve actuators and two-wire digital controls (Figure 2). Located near the Sea of Marmara, the 53-year-old refinery is the largest of four refineries operated by the Turkish Petroleum Refineries Co. (www.tupras.com.tr), and it produces more than 11 million tons of LPG, naphtha, gasoline, jet fuel, kerosene and diesel fuel annually.

Besides the retrofit, Tupras was also expanding and building new refinery facilities on an adjacent site with help from Técnicas Reunidas (www.technicasreunidas.es), an EPC contractor based in Madrid, Spain. This part of the overall project required more than 400 of Rotork’s IQ electric actuators.

Back at the retrofit, Tupras Izmit is implementing Rotork’s IQ intelligent, ATEX-certified explosion-proof, electric valve actuators to automate manually operated valves on the refinery’s tanks. Nearly 800 of the compact actuators are being installed on existing valves, while 100 will consist of new, actuated valve packages, both of which are able to fit in tight spaces.

In addition, all of the valve actuators will be monitored and controlled via Rotork’s Pakscan P3 two-wire digital bus network, which uses a proprietary, fast-update communications protocol, and has built-in redundancy for security. It provides a direct interface with host control and SCADA systems, while simplifying the overall control network, which optimizes actuator functionality and increases reliability. Pakscan can monitor and control up to 240 field units without repeaters at up to 20 kilometers. Because of Tupras Izmit’s huge size, groups of IQ actuators in different areas will be monitored and controlled by 20 Pakscan P3 networks, each controlled by a Pakscan P3 master station, which provides a local center for monitoring and control and links the network to the site’s SCADA system.

Meanwhile, non-intrusive hand-held interfaces with secure, bidirectional links are used to set control parameters, and commission and download integral data loggers. This system performs all switch setting and commissioning functions that traditionally were only performed by removing electrical covers. Using the multilingual menu on the actuators’ display screens, valves can be quickly commissioned with or without main power connected. The same instrument can be used to download data to the IQ actuators, or upload diagnostics from their data loggers. These data loggers enable event-by-event histories of valve activity, including time- and date-stamped torque profiles produced during each opening and closing, to be generated. Using Rotork’s IQ-Insight software on a PC, this data can be compared with valve torque signature profiles logged during commissioning to identify trends, such as valve operating wear.

Much of the retrofit is being carried out by Omas Teknik Pazarlama (www.omasteknik.com.tr), which is based in Istanbul, and represents Rotork in Turkey. Its responsibilities include design and fabrication of valve adaptations, installing the new actuators, commissioning and on-site support.

Pete Kundin, general manager of Rotork’s eastern U.S. division, reports its smart actuators work with its free Insight 2 software, and enable users to access their data via several avenues. “Bluetooth or infrared devices can download data from our smart actuators, and then upload it to a PC running Insight 2,” says Kundin. “Now our IQ3 actuators allow users to read operating data on a screen on the actuator itself. Finally, we’ve been gathering valve information via digital networks for 20 years, but valves still need six or seven control wires. However, two-wire, twisted-pair fieldbuses are getting more sophisticated, and our application-specific Pakscan fieldbus lets us put valves right on the network, and our Pakscan master station gateway lets us communicate via Modbus to other fieldbuses and Ethernet networks.”

Also, Kundin reports that Rotork developed and launched two other recent innovations: control valve actuator (CVA) is an electric actuator that’s more accurate than traditional, spring-diaphragm, pneumatic valve actuators and saves on air generation, and compact modulating actuator (CMA) is a more compact device for replacing legacy actuators. “We’re even looking at developing triple-offset butterfly valves as a replacement for standard gate valves,” he adds.

Long Distance, No Runaround

Another advantage enabled by recent valve innovations is that they’re much better at networking with higher-level control and enterprise systems, which can save operators lots of time-consuming labor and travel. For instance, Santos (www.santos.com) is one of Australia’s largest oil and gas suppliers, and it
Valves and Actuators

recently worked with Emerson Process Management to coordinate and improve upcoming operations across its $18.5-billion Gladstone LNG (GLNG) project in Queensland.

Emerson is the GLNG’s main automation contractor (MAC), and it’s providing equipment and expertise to help Santos gather and integrate real-time information from thousands of wells. Emerson technologies at the GLNG project include Fisher valves, Bettis actuators, Roxar multiphase meters, DeltaV digital automation system using CHARMS electronic marshalling, Rosemount measurement and analytical instruments, remote operations controllers and AMS Suite predictive maintenance software.

The pioneering project will convert coal seam gas to LNG for export to global markets. Gas from the Bowen and Surat Basins in eastern Queensland will be transported by a 420-kilometer, underground pipeline to an LNG plant on Curtis Island, located near Gladstone on the coast. Meanwhile, Santos’ remote operations center in Brisbane is approximately 500 kilometers south of Gladstone, but it integrates data from GLNG’s gas fields, pipelines and plant for real-time, 24/7 monitoring and collaboration with teams in the field. The GLNG project is on track to make its first

Figure 2: These are just a few of 800 Rotork IQ intelligent, electric valve actuators being installed on existing valves and 100 new valve actuator packages being installed at the Tupras Izmit refinery’s tank farms in Turkey.

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LNG shipments in 2015, and initial capacity is planned to be 3 to 4 million tons per year.

Santos and Emerson collaborated to plan and equip the Brisbane remote operations center where management, engineers and planners can use real-time information from the intelligent field devices to anticipate issues, collaborate, improve decisions and take actions to maximize key performance indicators (KPIs). “We’ve developed a remote operations center that’s changed the way our gas fields are operated in the Bowen and Surat basins,” says Rob Simpson, Santos’ general operations manager. “We now have the ability to centrally monitor the production and progress of our intelligent assets up to 1,000 kilometers apart.”

Similarly, another recent valve advance from Emerson is its Multiport Flow Selector (MPFS), which is used for testing oil and gas well liquids during production. Before MPFS arrived, these requirements were accomplished by opening and closing a series of flow manifolds to individually test the constituents of a hydrocarbon flow from the wellhead. However, MPFS is a single, compact system with a rotating plug that allows the flow from one well to be diverted from production for testing, which reduces the required number of valves by two-thirds. When coupled with an Emerson Bettis electric valve actuator specifically designed for it, MPFS can precisely control the flow, and automatically switch diverted well flow remotely from a control network.

Wireless and Other Futures

Probably the biggest innovation bringing valves and users together is the ongoing emergence of wireless for delivering field data to control and enterprise applications. “Wireless means cost saving, more intelligence and better diagnostic capabilities,” says John Hancill, Emerson’s strategic marketing director for R&D in Emerson’s rack-and-pinion actuators division. “We view our Smart Wireless capabilities as creating opportunity for customers to implement solutions that were previously operationally or cost-prohibitive. Also, Emerson’s use of Wireless HART creates a flexible, secure and reliable network, but wireless also allows users to remove people from potentially hazardous environments. Finally, we’re also partnering and solving customers’ problems using wireless valve operating systems with pneumatic or electric actuators.”

Jim Montague is Control’s executive editor.
Calibration Can Be Condition-Based

Process plants abound with instruments, analyzers and control valves, all of which need calibration to ensure performance as designed. Many plants calibrate these devices at fixed intervals, but that’s less than optimal for a number of reasons. First, it’s expensive, as many devices can operate within parameters on extended calibration schedules.

Second, it can result in poor operating performance, as some critical instruments should be calibrated more frequently. Third, plant safety can be compromised if safety-related devices drift out of calibration between intervals.

Calibrating each device only as needed is the better method, and that requires automating the calibration process. Smart devices can provide information to an asset management system (AMS) or a calibration management system (CMS) over a digital data link. These systems use this information to determine optimal calibration intervals. They also send data to documenting calibrators, which are used to calibrate the devices. After calibration, these calibrators upload the “as left” condition of the device to the system.

Here’s how it works in practice. “Our customer GlaxoSmithKline (GSK) has a pharmaceutical manufacturing plant in Cork, Ireland, with more than 4000 control loops with HART and Foundation fieldbus,” says Laura Briggs, the product manager for asset optimization at Emerson Process Management (www.emersonprocess.com).

Plant personnel were routinely calibrating instruments that did not need the same level of attention as devices that were critical to product quality or safety. To determine which instruments could be moved from the periodic schedule to on-demand calibration, they examined the diagnostics generated by every smart field device and digital valve positioner using Emerson’s AMS Suite predictive maintenance software. They began monitoring a select group of less critical instruments, waiting for them to indicate that a change had taken place internally requiring attention. As time progressed, all of the smart devices were migrated to on-demand calibration.

Streamlining regular calibration procedures is based on optimizing the plant’s periodic calibration schedules using documenting calibrators and synchronizing instrument data between Beamex’s (www.beamex.com) CMX CMS and Emerson’s AMS Suite. Calibration data on every instrument is stored and downloaded directly to a portable calibrator for use by a technician in the field. When the scheduled calibrations are completed, the results are uploaded for certification and documentation.

“Savings due to this paperless calibration procedure were 15 minutes cut from each calibration, 21,000 sheets of paper eliminated each year and more than 500 hours per week of manual data entry time eliminated, along with potential errors,” notes Briggs.

GSK also extended the interval between calibrations to reduce the overall number of procedures done annually while remaining in compliance with corporate policy and government regulations. The company achieved this through an ongoing, computer-driven analysis of historical data to identify instruments that didn’t need to be calibrated as often, resulting in an 8% reduction in scheduled calibration.

Substantial upfront effort is required for any calibration optimization project. “The most time-consuming aspect of getting started isn’t the acquisition cost of the equipment or software, but rather populating and setting up the AMS or CMS software with the information from the critical tags and their calibration attributes,” explains Jim Shields, process tool marketing manager, Fluke (www.fluke.com).

“Once the CMS is populated, the data can be mined to make more educated determinations of instances where maintenance intervals can be adjusted,” Shields adds. “Most CMS packages have tools for drift plot analysis to help examine the performance of a device, its errors and drift since its last calibration. If these or other tools show a device is performing reliably, then it’s a good candidate for an extended maintenance interval.”
Direct vs. Reverse-Acting Control

“Ask the Experts” is moderated by Béla Lipták (http://belaliptakpe.com/), an automation and safety consultant, who is also the editor of the Instrument and Automation Engineers’ Handbook (IAEH). If you have an automation-related question for this column, write to liptakbela@aol.com.

Q As I understand it, if the controller output increases when the measurement value rises, it is a direct-acting controller, and if controller output decreases when the measurement rises, it is a reverse-acting controller. In addition, at minimum output of the controller, the desired fail-safe action must be achieved. For example, if we have two controllers on a distillation column—reflux and net overhead—where the reflux control valve is fail-open, and net overhead control valve is fail-close, the reflux controller will be reverse-acting, and the net overhead controller will be direct-acting. Is my understanding correct?

Vasant Warke
vasant.warke@ril.com

A Valve failure position and controller actions are independently determined, therefore, let’s talk about them separately.

Valve failure position is determined by safety considerations. If, in case of failure, you want your column to go on full reflux, your selection is right (Figure 1). Assuming that the valve actuators are spring-operated pneumatic ones (you did not say what they were), and assuming that you define “failure” as the loss of air supply, the spring will act to open a fail-open (FO) valve and to close a fail-closed (FC) valve, regardless what the controller actions are. (I neglect to mention the role of positioners because I don’t like to use them on flow control valves because they can be slower than the flow process and, therefore, they can cause cycling.)

Now let’s turn to the subject of controller action. Assuming that your system is as shown in the figure, an increase in column temperature should result in increased cooling, which is accomplished by returning more cold reflux into the column. This means that the temperature controller (TC) has to reduce the reflux flow setpoint, which in turn will increase the level in the accumulator, and to overcome that, the level control (LC) increases the setpoint of the reflux flow control (FC). So a measurement increase requires the TC to reduce its output (reverse action, R/A), while the LC increases its output upon a level increase (D/A). The response of the slave FC controllers is to increase the flow through their valves as the master raises their setpoint, so with the FC valve, it will be D/A, and with the FO valve, it will be R/A.

Béla Lipták
liptakbela@aol.com

A Direct action means that the controller output rises if the measurement increases. Indirect (reverse) action means that the controller output drops when the measurement rises.

Al Pawlowski, PE
avp2@almont.com

A Not quite right. The control valve failure action (and sometimes the valve positioner action) is also relevant. To ensure that you have an overall negative feedback, you need to follow the entire loop from sensor (increase/decrease output as variable increases) through the controller (where you...
I believe you have your cause and effect backward. I think only of the controller. Consider the input (process variable) to the controller as the cause and the controller output as the effect. If the controller is set for direct-acting, then an increase in PV will cause the output to increase. If the controller is set for reverse-acting, an increase in PV will cause the output to decrease.

To make the correct setting for direct/reverse-acting, you have to consider the process effect all the way from the controller output to the process variable. Does a controller output cause the valve to open or close? Some valves are fail-open; some are fail-closed. Does an increase in valve position cause the PV to go up or go down? Opening a steam valve to a heat exchanger (HX) would cause the HX output temperature to rise, whereas opening a cooling water valve would cause the HX output temperature to go down.

In summary, considering all the effects between the controller output and the PV, if an increase in controller output causes the PV to rise, or a decrease in controller output causes the PV to fall (that is, the PV moves in the same direction as the controller output), then the process can be called direct-acting, so the controller should be set for the opposite, reverse-acting. Thus, if a process disturbance causes the PV to rise, the reverse-acting controller will decrease its output. Consequently, this decrease in controller output will cause the direct-acting process variable to decrease, thus moving it in the opposite direction from that which caused the disturbance.

A level controller, whose output controls the valve on the tank inlet, is reverse-acting, but if the valve is on the outlet, it becomes direct-acting. A temperature application can be controlling cooling water to an exchanger (direct) or a cooling water bypass (reverse). I can’t think of a way to make up a rule for a clerk or a computer algorithm that states some simple “if this, then this” for direct-or reverse-acting. Maybe I’m slow, but I still have to think through each application.

A The controller action is relative to the definition of the error. If error = setpoint – process variable, then a reverse-acting controller will cause the process variable to decrease when the controller output increases, and vice versa.

Valve fail position is not a function of the controller, but a function of safety, or zero energy in case of a failure in the energy supply to the final control element. DCSs have different ways to deal with fail position and controller action, and the configuration should be made according to what makes sense to the operation.

I believe that your understanding of direct/reverse-acting values is correct. However, the fail-safe action has nothing to do with direct/reverse action. The failure action is dictated purely by the position of the spring against which the pneumatic diaphragm operates in the control valve actuator. They’re defined independently when the control valve is specified (fail-safe action) and again during configuration of the control valve positioner or the controller outputting to the control valve (direct/reverse-acting).
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Media Converter Puts Ethernet on Blue Hose

The inspiration for ProSoft Technology’s new Ethernet to Belden Blue Hose Industrial Media Converter came two years ago at Rockwell Automation’s Automation Fair. “A customer came to us with a problem with his Remote I/O system,” says Ken Roslan, vice president, global marketing, ProSoft Technology (www.prosoft-technology.com). “Rockwell Automation is discontinuing Remote I/O and has given a one-year notice. Users need to upgrade, but the new Flex I/O requires Ethernet, so they are faced with replacing their network wiring.”

Roslan says there are several hundred thousand Remote I/O systems in use, many using PLC 5 and SLC controllers connected with Belden 9463 “Blue Hose” wire. “Blue Hose wiring has been the industry standard for Remote I/O networks,” he says. “Over the past 20 years, Belden has produced and sold more than 391 million feet of Blue Hose—enough to circle the globe three times—and much of it is still in use in facilities all over the world.”

Typical systems have 1,000 to 10,000 feet of cable. To put in a new control system, plants would have had to add Ethernet using Cat 5 cable and managed switches, with fiber for distances over 300 feet. “Just running the cable itself can be a challenge,” Roslan says. “Then they have to convert programs and schedule downtime to install and commission the new system. That’s when risk starts going up.”

The new converters allow users to upgrade an Allen-Bradley Remote I/O system by running Ethernet communications over the existing Remote I/O network. “Your cable company runs cable TV and Ethernet over the same coax cable,” Roslan says. “We applied that same idea, but over Blue Hose, which is twinax.”

These converters support 57.6-K and 115.2-K baud rates, and the units are plug-and-play with no configuration required. “You connect to the Blue Hose and power up. There’s no setup,” Roslan says. “It’s completely transparent, like an Ethernet-to-fiber-optic converter.”

The system is tailored for retrofits. “A lot of this Blue Hose cable has been out there for many years, at different lengths and various levels of deterioration. The converters monitor communications, and pick the best broadband channel for the installed condition of the cable,” Roslan says.

The converters provide more than the ability to avoid replacing cable. “You can change one thing at a time during a scheduled shutdown,” Roslan says. “You can continue to use an old controller while you install a new controller, convert the code, and use a remote I/O card to test the code while the plant is running on the old controller, then switch over.”

This approach allows users to upgrade I/O as needed—one node at a time—and move it over to Ethernet. “Being able to simultaneously run Ethernet and Remote I/O lets you make changes with minimal downtime and little risk,” Roslan says. “You can upgrade a node and use the old I/O as spares for other old nodes to buy time before you need to replace them. In effect, you’ll never have to replace the network cable.”

One master handles multiple slaves with cable runs up to about 1,750 feet. As many as eight repeaters can be used to extend runs to 10,000 feet, with as many as 32 nodes, the same maximum network size as Remote I/O. Supporting a minimum of 1 to 4 Mbps, speed is at least 10 times as fast as Remote I/O, and it can handle bursts as high as 20 to 30 Mbps. That Automation Fair attendee’s problem has been solved. “Customers who previewed the product said, ‘You can’t do that,’ but that isn’t true anymore,” says Roslan. “It works just like Ethernet over coax; it’s just a different technology.”

For more information, visit psft.com/eiprio.
From Loop Control to Process Performance

Stan: Last November’s column with George Buckbee, “How to Get the Most out of Your Loop” (November 2013, http://bit.ly/1d10QAr), gave a good introduction to loop performance that set us up for the next step: How do we get from loop control performance to process economic performance?

Greg: Lewis Gordon, a principal control systems engineer retired from Invensys after 38 years, has submitted some comments on improving loop performance to increase plant profitability. Lew specialized in control applications design, tuning and loop performance monitoring software (ExperTune’s PlanTriage). Here are Lew’s comments on the column with Buckbee and more details from a subsequent conversation.

Lew: George is absolutely right in saying that improving loop performance is about more than tuning. He mentioned some specific examples, including loops in manual, root causes, interaction, stiction, backlash and faulty instrumentation and/or actuators.

In the case of controllers in manual, this is sometimes not a significant issue. A controller may be in manual simply because it has become obsolete (out of service) or because the current process operating mode doesn’t require it. Certainly, a controller that’s always in manual is wasting the cost of its installation, as the column makes clear. But it’s also possible for each of two reciprocally interacting controllers to be stable so long as only one is in auto, but for both to cycle when they’re in auto at the same time. Both of these situations do happen, but not often. More significant for the long term are those loops that don’t control well enough during process upsets. Often, on difficult-to-control loops, the controllers are in auto, but tuned sluggishly to keep the loop stable under most operating conditions and hold steady state in the absence of upsets. Then, manual/operator control is used to handle occasional upsets. So two revealing metrics are the frequency of auto/manual transfers and the frequency of output changes in manual, which most loop performance software also tracks.

Among Stan’s and Greg’s “Top 10 Uses of Old Performance Reviews” are as fire starters “for fun times next to the fireplace or barbecue reading Performance Enhancement Process (PEP) stories.” Find the rest of the list online at http://bit.ly/1hyMfnp.
**CONTROL TALK**

*Stan:* If the output of a controller in manual is not being adjusted by the operator, closed-loop control is probably not that important.

*Lew:* In either case, retuning such loops can improve control performance, especially during an upset, and reduce operator load. Nevertheless, this improvement is unlikely to have significant economic benefit without changes to the average operating point.

The other examples mentioned certainly exist, and when they’re found and corrected, the benefits will be very welcome. Backlash and stiction are almost pervasive. They cause oscillation too, but these situations can be distinguished from gain-driven oscillations because the oscillations they cause are self-limiting. If the deadband and stick-slip are less than 1%, the limit cycle may be more of a nuisance than a significant economic problem (unless it affects one of the variables mentioned in the next paragraph). They do create a maintenance issue because of the associated wear and tear on the valve. However, such cases can go on for months and even years without being addressed because their economic and operational impacts are not large enough to demand a solution. Similarly, instances of faulty instrumentation that have significant effects, such as George describes, provide surprising and dramatic improvements. However, they’re usually singular situations—not really part of a long-term continuous improvement concept, except as gateway events.

A process of continuous improvement is the real money-maker, enabled by tuning and control loop performance monitoring (CLPM) software. The article pointed toward the most beneficial reason for using CLPM software to improve control performance in auto: to minimize variation (reducing standard deviation) in the PVs that affect plant’s economic performance. The key point is that more stability often allows the operating point for economically significant variables to be moved to values that provide increased production rates, higher yields, lower energy costs per unit of production, longer equipment life, more uptime and fewer emissions violations and fines. These improvements may be less dramatic than killing a troublesome oscillation, but they’re where the big money is because their return steadily accumulates over time. An improvement in any of these areas of just $150 an hour will return over $1.25 million a year. Every plant is a “target-rich environment” for such opportunities, to borrow George’s phrase. A plant of any size will make millions of dollars’ worth of product a year and consume millions of dollars’ worth of energy. Even small percentage improvements in either of these factors can generate a huge return on investment (ROI) for the effort required at no capital cost.

*Stan:* How do you find out if a loop that is not performing affects plant economic performance?

*Lew:* Identify the process variables that relate to energy, raw material use and product value. Often these process variables are associated with product quality or composition. Maximizing an impurity is a prime opportunity. Two examples are maximizing the moisture in the product from a dryer and air in ice cream packed in a container, without violating quality specs. This optimization reduces the raw material and energy used per unit of product sold. A chemical engineering example is maximizing the impurity in a higher-value product stream. In distillation, this is often the overhead light fraction, and the impurity is the heavy fraction. Reducing over-purification can save a lot of energy and increase product yield per unit of feed.

*Stan:* Why are operators reluctant to push closer to a constraint?

*Lew:* Because process gains are often higher and quality violations more likely closer to a constraint. The possibility of a safety system or relief device activation also increases as you get closer to a constraint. This can get operators into trouble, but better control performance allows them to control at more profitable points with more stability, safety and confidence.

*Greg:* Can software automatically point the engineer to the root cause of a problem whose solution can provide significant potential benefits?

*Lew:* A single variable is often affected by a number of other variables. Loop performance monitoring software uses power spectrum analysis to point to other variables with common frequencies that may be major contributors to the variability in a key variable. Interaction maps use color-coded XY grids to indicate strength of interaction. Still, you need to know how the interactions flow. The software does not determine if the dog is wagging the tail, or vice-versa. Someone with process understanding, a person who can determine what is upstream and downstream and what happens first, needs to look at how mass and energy flow through the system.

The amplitude and period of an oscillation also are important clues. If the amplitude is stable, the cause is most likely deadband or stick-slip. If the period is quite large relative to the dead time, the cause is probably a load disturbance. If the amplitude decays or grows, the cause is probably related to controller tuning. Cycling from aggressive tuning is the least likely cause, since most loops are tuned sluggishly. The most common cause of oscillations is deadband and stiction. Next are interactions. In the case of interaction, you can sometimes minimize the interaction by tuning the two loops to cycle at more separated periods similar to what is done for cascade control. ■
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Sitting Is the New Smoking

So I’m sitting here writing this column. A few days ago, I was sitting here writing this issue’s “Perfect Fit” cover article on all the different ways to improve operator performance. As the years have whizzed by, I’ve noticed after a few hours of sitting that I sort of begin to congeal like Jell-O in a mold. Now I’m already up to my neck in a tub of Crisco, metaphorically speaking, but this is different than flab because I can tell my bones, muscles, joints and even my skin are growing increasingly rigid. Yes, I have cankles, too.

Luckily, I also get some occasional exercise, and I always feel better when I can stretch, walk or ride the old Schwinn Airdyne exercise bike. Sure, I get pretty winded with most exertion, but I’ve also noticed that it isn’t the activity that makes me sore, but the inactivity afterwards when every muscle contracts and sets like plaster. It’s logical that exercise gets the blame for pain, but it’s the long-term sitting or lying down that’s the real enemy, even though resting briefly after exertion is an undeniable blessing. It’s the duration of the inactivity. This is an important point.

So while sitting and interviewing sources on the phone for my “Perfect Fit” story over the past few weeks, I perked up when a few mentioned the potential danger to process applications and operators of sitting too long. They stressed waning awareness of process control indicators, alerts and alarms, but they also focused on the long-term health problems for operators and any desk jockey due to their sedentary workplaces and lifestyles. A couple even reported hearing a new phrase, “Sitting is the new smoking,” to illustrate how unhealthy inactivity can be. I can believe it.


When I’ve covered operator effectiveness in the past, some control room designers reported adding small exercise rooms next their control rooms. These supposedly help operators get in short workouts to help revive them. This year, several suppliers explained they’ve been going one step further, and providing consoles and workstations with “sit/stand” options. Honeywell Process Solutions, ABB, Winstead and others offer variations on the sit/stand concept.

The good news is that sit/stand workstations not only fit operators of different sizes to begin with, but also allow them to adjust their workstations for either activity throughout their shifts. Early reports from users are that being able to shift positions and more around more freely improves comfort and awareness.

So why is this? Well, I’m betting it all goes back to our good, old hunter-gatherer biology. Legs are bigger than arms because we’ve been walking around for food ever since we left the trees. We’re hardwired, so to speak, to be standing or walking during most of our waking hours.

Long ago, I did a feature story on a bow hunting club in Algonquin, Ill., and their research indicated that most primitive hunters waited in trees for prey to come by, but after getting a shot off, they usually had to walk after it for hours or days until it fell down. Then, they had to cut what they could carry, and walk all the way home. Not easy, but very good aerobics.

In our modern era, the hunt only lasts as long as the five seconds it takes to get to the refrigerator. This is much more convenient, of course, but not much of a challenge and not really even a tiny workout. Most of us need to get our blood and other fluids pumping through our biological process facilities for periods closer to those long walks of old.

So even though I don’t have a sit/stand station, I will put a cardboard box under my notepad and PC, and do as many interviews and as much writing as I can in a vertical position. How about you?
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