INSIDER
INDUSTRIAL AUTOMATION & PROCESS CONTROL

In September, Walt Boyes gave the Keynote Presentation for the Beamex Annual Calibration Exchange 2022 in Houston TX. As he has done before, he combined the concepts of calibration with his experience as a professional Futurist and spoke about two significant topics: calibration and the concept of the Digital Twin, and the effect of calibration on cybersecurity. (Walt donated his speaking fee because Beamex makes a large donation to a local instrumentation technician training school at the end of every ACE event.)

In this issue:

CALIBRATION AND THE DIGITAL TWIN

The Future is not coming. The Future is here.

I am a professional futurist. That means I think about what the future will be like. The future of manufacturing in both the discrete and process industries will be very different from what we've known. We think of our plants, our factories, as physical things– buildings, roads, pipelines, reactor vessels, storage tanks– all manner of ***stuff.*** Industry 4.0 is not about stuff. It is about something worth much more than the entire plant, land, and all: DATA!

Imagine what that means. First, with enough data you can see what the plant is doing. You can see where the bottlenecks (the "Herbies") are. You can see what the efficiency of the plant actually is. You can model the behavior of the plant and all its systems and find out what happens if you do *this* or do *that instead*. You must have as much data as you can get. You have to have the means of dealing with it, and that is what Big Data engines are all about. The problem is to be sure you have the right data, the data you need to make decisions with. It is the data that is generated by all the ***stuff*** that makes up your plant.

Buzzword Bingo!

Not a day goes by where some industry guru like me tries to get you to play BUZZWORD BINGO about Industry 4.0. So, I'm not going to do it. What I am going to do is talk about data and what you can do with it.

Let's talk about the famous buzzword, "digital twin."

- What is a digital twin?
- How do you make one?
- What is it good for?
- What does calibration have to do with a digital twin?

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What Is a Digital Twin?

A digital twin is simply a very high-fidelity model of the processes going on in your plant. If you think of the plant as a beehive, the data is all the bees as they work and move around making honey and feeding the queen. When you first look at a beehive, it looks like a jumble of purposeless activity. After a while though, you start to see relationships in the movements of the bees. In the high-fidelity model of your plant, if you study it, you begin to see the relationships of the interaction of the systems in the plant. The nice thing about a digital twin is that you can stop it, run it backwards, run it again. You can't do that with your plant itself.

How Do You Make a Digital Twin?

Even though all the vendors show you fully developed top-down views, a digital twin is really built from the bottom up. Start with a pump. It has a motor, a coupling, some sensors, some switchgear, valves, and piping and wiring. It is a *system*. Each of the components of the system produces data. The pump produces flow, pressure, temperature. The motor produces RPM, vibration, temperature, power draw (amperage). The valves produce data. Even the piping can be mined for data for corrosion resistance, or scaling. You model this data, and you have a digital twin of this pump system. You can add it to all the other digital twin systems you have from the data in your plant. Finally, what you have is a detailed, high-fidelity model of your entire plant operation. That's the plant's digital twin.

What is a Digital Twin Good For?

The concept of a "digital twin" comes with lots of baggage from consultants and industry gurus like me. That's because they are selling to the C-level in the executive suites. But the fact remains that putting together and maintaining a digital twin of your plant is good for you, whether the C-level agrees or not.

We are running our plants close to the wall. Sometimes we're running our plants at well over 100% of design capacity. I know of refineries running at 125% of design. Day in and day out, these refineries (and other plants, both process and discrete) need to keep running without unplanned failures. The only way to minimize unplanned failures is to use the digital twin ahead of any failures. That way you can see how the plant behaves under different conditions, including simulating failures and looking at recovery scenarios.

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One of the significant uses of digital twins is the ability to train operators on realistic plant simulations. For example, you can show an operator a scenario in which a polymer reactor train fails and show the operators how to minimize the potential disaster. That way you don't have to send your people in with hammers and chisels to chip out the hardened polymer.

But one of the most important uses of a digital twin is to help maintenance engineers and operators develop cause/consequence models and prescriptive maintenance strategies. Using Artificial Intelligence to enliven the digital twin model means that you can make your twin even more accurate with every iteration.

But in order to have an accurate digital twin, you have to have accurate information coming from your sensors and instrumentation. The way to ensure that is to institute a formal, continuous calibration program, and keep it operational. Using digital calibration techniques, the data can easily be added to the data lake of the digital twin. Without a continuous digital calibration program, you cannot expect your digital twin to remain accurate and reliable.

Cybersecurity and Calibration

Joe Weiss from ACS and I have been talking about this for a dozen years now, at least. Level Zero in the Purdue Manufacturing Control Model has no cybersecurity protections. We are continuing to talk about this, because it matters. It is a huge hole in the cybersecurity protections of manufacturing and process plants worldwide.

It was fine when instruments were dumb and only did one thing…measure one variable and output it on a 4-20 mADC current loop. But it is not fine when we are talking about smart instruments, wireless instruments, and multivariable instruments. It's not fine when data from these smart instruments is being sent to cloud servers and used to monitor and even control the processes in refineries, chemical plants, and pipeline, energy, and water SCADA systems.

The data you get from your sensors is the lifeblood of a digital twin. Your entire plant runs on the input data from your sensors: flow, pressure, temperature, density, pH, vibration, and more. Those sensors MUST be accurate, repeatable, and reliable. Your control systems and your operators have to know that the values their instruments are reporting are the real values the process is producing. Imagine what would happen if your operators could not trust the readings

ISSN: 2334-0789

from your plant's instruments. Well, right now, there is no way to protect your instruments against cyber attack. It has happened, according to Weiss, and keeps happening.

Automated digital calibration routines keep your sensors honest. If you calibrate your sensors on a regular basis, you eliminate the ability of an intruder to falsify your sensor readings for any length of time. Letting a maintenance AI use that data to extrapolate a trend will allow you to see the spikes caused by potential intrusions. You can stop them before they get entrenched in your instrument, and before your false instrument readings causes your plant to run away.

Honest sensors keep your digital twin accurate, and having an accurate, living digital twin helps keep your plant running on the cutting edge of performance.

Like I said, *the future is not coming. The future is already here.*

Industrial Storytelling, Part One

Communicating with your customers, your employees and staff, your stakeholders, and the relevant media is all about telling stories. If you are in charge of communications for your company or other entity, remember that your job is to be storyteller-in-chief.

When you tell stories, remember what it is that you like in a story told to you. Do you want to hear about how great the storyteller's company is? How many awards they've won? Do you want to know how much money they've made?

Do you want to know about the products in excruciating detail? Do you want the centerpiece of the story you're being told to be the specifications of the product? Or do you want something else?

Most people couldn't give a rodent's tail for product specifications beyond a certain point. As a highly irritated customer said to me a number of years ago, when I was doing the Feature-Function-Benefit rap for them, "I assume it will work or you wouldn't be showing it to me. What I want to know is whether it will work in my application the way I want it to. Cut to the chase!"

We are all in love with our products. We created them, we crafted them, we built them and we love them because they are ours. The customer really doesn't care. So the stories you tell have

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to be relevant to the customer. They have to address the customer's actual needs. They have to fill that hole in the customer's want list that your product can slip right into. Or you are wasting your time.

Your story has to be SMART. It has to be specific, meaningful, actionable, relevant and timebound. If you recognize this acronym, good. You will notice that it is a little different than the original acronym.

You have to craft a story that is specifically aimed at the customers you seek. It must be entirely meaningful to them in a way that makes sense to them without them having to figure out what your meaning is. Your story must have a call to action in it, or it won't work, and you'll have wasted your time. It must be entirely relevant to the world of your customer. If your customers are plant operators, telling them a story about data mining engineering might not be all that relevant to their lives and work. Your story must also be timebound. You can tell a story that begins, "Once upon a time…" but if you do, be prepared for the customer to tell you, "Well, someday we might want to do that." Timebinding establishes the urgency of your story.

More about storytelling next time!

WALT BOYES is a principal with Spitzer and Boyes LLC. He is a Life Fellow of the International Society of Automation, a Fellow of the Institute of Measurement and Control, a Chartered Measurement and Control Technologist, and a member of the Association of Professional Futurists. From 2003 to 2013 Walt was Editor in Chief of *Control* magazine, and from 2014 he has been Editor and Publisher of the INSIDER. From 2016 to 2022 he acted as Editor of the alternate history magazine, *The Grantville Gazette* and as Editor in Chief of *Eric Flint's Ring of Fire Press*. Walt is available for consulting and for speaking engagements both in person and online.
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