[music]

Erik: And this is where the technicians that are touching the machines day in and day out, the operators that are working with them. They're a prime source of finding those right opportunities, addressing things that are a pain point. And when it comes from that person who has that daily hands-on experience with the system, that's the gold mine right there. That's where you're going to get your best opportunities for improvement.

[music]

Mike: From the Center for Occupational Research and Development, welcome to Preparing Technicians for the Future of Work. I'm your host Mike Lesiecki. In each podcast we'll reach out to people who are actually on the front line of the future of work and hear what they have to say. That means interviews with industry, interviews with working technicians, forward thinkers in the field. We'll do some background research and we'll curate that research to make sure you have the most up to date and relevant information. And in every episode, we'll suggest action that you can take. We want to inspire you to take that action.

This podcast is brought to you by the Center for Occupational Research and Development, known as CORD, with financial support by a grant from the National Science Foundation's Advanced Technological Education program. Opinions expressed in the podcast do not necessarily represent those of the National Science Foundation. You can find out more about our project and our approach at "PreparingTechnicians.org."

Our guest today is Erik Fogleman. Erik's a Senior Technology Consultant with ConnStep out in Connecticut. And at ConnStep, Erik provides a broad technical and market understanding of automation and Industry 4.0 products and applications. Erik, that sounds pretty good. Thanks for joining us today.

Erik: Thanks, Michael. My pleasure to be here.

Mike: Tell us a little bit about your own background and your firm ConnStep and what you actually do there.

Erik: Absolutely. My background is electrical engineering and business by education. And I spent the last 20 years or so in and around the manufacturing industry. So, I've done a number of things from being somebody running a machine out

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on the floor to the technician fixing it, all the way up to working for distributors and suppliers of manufacturing equipment to help customers implement solutions and get things up and running on their floor.

So, a little bit about ConnStep we're part of what's called the Manufacturing Extension Partnership—the network of companies that's overseen by NIST. And our role is to work with the small and medium manufacturers in our areas, give them access to resources to help them in their business, help them grow and compete in an increasingly global market, and help them get access to some of the knowledge and expertise they might not otherwise have.

So, my role within ConnStep is to help our clients look at some of the business challenges they have and how we can bring technology solutions to help address those. And I think that's one of the foundational principles that I've always worked from in my career -- that I don't like just throwing technology at a problem just for the sake of something shiny and flashy. There's got to be a real impact. There's gotta be a solution that helps make the business stronger or better.

Mike: That sounds good, Erik. I was just intrigued by... You mentioned this—the National Institute of Standards and Technology—and they have this Manufacturing Innovation Blog. And I read your and your colleague Jeff Orszak's blog posts there. It was just fascinating. The title of it was "The Future of Connected Devices." And, you know, Erik, you and Jeff painted this vision of a production system that can actually sense and analyze and respond. That was pretty exciting to think about. Tell us more about that vision and importantly, what implications does it have for our project, Preparing Technicians for the Future of Work?

Erik: Yeah, the vision that we kind of look at for what's coming up in the future. And this is something that's really encapsulated by this whole idea of Industry 4.0 and things like the Internet of Things, cloud computing, some of those technologies that make that up. The idea there is that when you apply some technology to some of these things... And I'll give you kind of a specific case of a machine.

So, if you have a machine that's cycling a pneumatic cylinder, one of the most basic pieces of automation technology that's out there. Over time, what starts to happen is different things within the cylinder are going to

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wear down. You're going to get seals that will start to wear. You might get air gaps in there. You might get increased friction. And typically, what will happen is that will be run until the thing blows apart. And parts start flying everywhere. And then what happens in that case is you're doing a rush order to get new parts. Your machine is down. You're losing productivity. You're losing money. So, that's money going down the drain.

And so, the idea here is that you can take a sensor that's going to start to detect changes. That's measuring what's going on. It's going to be able to see small changes in temperature or pressure, or even changes in the sound and vibration that the system is putting out well before the human ear can detect it. And then some intelligence in there, if you have a processor that's looking at those things and seeing how it changes over time, it's going to start to see this trend that "something's going wrong." "Something's out of normal operating conditions," well before a technician can pick it up.

And we look at some of those things where I've seen a lot of technicians are, I've been the technician that'll go around and you go through this checklist process at the machine. And, you know, we always used to joke that you've got to have good sensitive fingertips and a good sensitive nose, because those are some of the things that you look for. Is something hot that's not supposed to be? Or does something smell, kinda "off?" Or does it sound a little "off?" And so those things that we kind of train ourselves to look for over time, we start to see this ability to pick up on it well ahead of time, see the trends that the human ear and eye and hand can't sense, and then start to make some decisions.

And the goal is not necessarily to say let's take the human element out of there, because there are certain things that we're just never going to be able to program a computer or an artificial intelligence entity to be able to make some of these judgment calls and some of these decisions. So, what I always like to talk to people about is, "It's not about replacing humans. It's not about taking them out of the decision loop, but it's more about, let's take some of the guesswork out of it. And let's give you, instead of just data that you have to try to interpret, let's give you actionable intelligence, so that you can make better

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informed decisions and make those judgment calls a little bit better."

And then as far as looking at how this impacts technicians out there, somebody on a production floor or working for a company. As we look at a lot of these smarter sensors, smarter systems, there's a shift in your role as a technician and your job. In previous times you'd have your tool chest and you'd have those same couple of tools that everybody had. You'd have your digital multimeter. And you go hook up to a sensor. You measure the output and you kind of test things and see if it's working right. Whereas now we have smart sensors that have diagnostics built in. So, you know, the job of the technician now becomes a lot more around—as opposed to taking those rudimentary measurements and making a judgment call—it becomes, "Let me dissect, and think over the information that's being presented to me from these devices."

Mike: You know, Erik, in your article, you use this term, the "intelligent edge." And, of course, that's related to edge computing, and industrial Internet of Things. But I'm not sure many of our listeners—and I'll put myself in that place as well—if I could tell someone else what the "intelligent edge" is, what that term means, I'm not sure I could do that today. So, can you help me? Can you help us give us a little primer—if that's the right word—on what the "intelligent edge" is, and why it matters to technicians today?

Erik: Absolutely. So, one of the things that really kind of came out of the whole Internet of Things and Industry 4.0 movement, one of the core technologies as you kind of alluded to is "cloud computing." And that idea that you could take... Instead of having to have all of these resources tied up within your facility, you could leverage computing power that somebody else is providing. One of the things that people have seen is, as you start to deploy more and more smart devices... And again, I'll kind of use the example of a production floor, manufacturing floor. As you deploy more sensors, more smart systems, more devices out there, there's a lot of data that's being moved around—number one. And number two, there's a lot of distance that, that data has got to go. So, if you're hosting all of your analytics offsite through a cloud service...

Mike: Right.

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Erik: ...there's some latency or some lag time involved in that data going back and forth and those decisions being made and then those decisions being communicated back.

And so we've started to see a move towards more of a hybrid model, where you still have some of your longer-term analytics going on in a cloud server type of setting. These are things where you're kind of watching the long-term trends. And things where you're taking that data about what's happening on the floor. And then applying that to what's coming up in terms of customer orders. What's coming up in terms of supply chain issues.

Mike: Yeah.

Erik: So, all those analytics can happen a little more in the background.

But then you have a lot of those things specifically in the case of machine condition monitoring, or feedback from a vision system, a camera. If you need to make a decision on whether a part should proceed to the next step of the process, or whether there's something that's out of alignment or out of specifications, you want to make that decision very quickly. The sooner you can address that and prevent that from moving on, you're eliminating wastes in your process. You're doing all of those things that we preach in Lean Manufacturing and those types of continuous improvement efforts.

So, this idea of having some processing power localized that still has the horsepower to be able to do some analytics and make some decisions, something with more horsepower than traditional PLC or small controller on a machine. And so, we've seen this move to this intelligent edge where you have these computers that sit kind of between that production floor and then the cloud system. And so, you share some of that load with the cloud system and then the edge computing. So, you have some ability to have the high horsepower, fast processors, lots of memory that you can throw at it. So, you can do some of those analytics right there, right on the spot, and you can make the decisions faster and you can maintain that closed loop control in a much tighter, faster fashion.

Mike: Sure. Does this also give an advantage in a "cyber secure" sense? Maybe the data has to be passed around less. Is that true?

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Erik: It is. Yeah, that definitely helps from a cybersecurity standpoint. There are devices out there from companies like Moxa and Phoenix Contact and others that allow you to have an industrial firewall that sits between the rest of the world and your manufacturing floor. So, all of your systems there. And what that does is it protects those cyber attacks where somebody is either trying to get in and go through the corporate network and try to sabotage your operations out on the floor. We've seen a number of those cases over the last 10-15 years.

Mike: Yeah.

Erik: But then also it prevents somebody from accessing vulnerabilities in production equipment and getting to the sensitive data in a network.

So, definitely that allows you to say, how much of the data do we really need to send to the cloud for some of those longer-term analytics. And you can streamline that and not have as much need to send all of that out there. And it allows you to do more of that processing locally, where you're behind that local protection, that local firewall and VPN.

Mike: All right. Good, good. That really helps. I've got a multi-part question for you now. So, I'm sorry to throw this all together. But you work with a lot of different companies and must see them making decisions to implement new technologies. Maybe it's automation. Maybe it's collaborative robots. Maybe it's something to do with their logistics system. But new technologies that are coming. You must see them do this. So, how do they know what's coming? How do they make those decisions? Do they use vendors? Is it a company strategy? And then once they've decided, how did they integrate them in? That's the two-part question: How do they know? How do they integrate?

Erik: Yeah, that's an excellent question. And that's one of the things that we address a lot with the clients that we work with. Awareness of what's going on. I wish there was a nice, easy website that you could go to and just say, "What's new that's important to me? What should I know about?" I think the key that we see is really to take a multi-pronged approach to that. The people that do a really good job of keeping a pulse on what's out there, they're using a lot of different resources. And unfortunately one of those has become a little bit more difficult in the face

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of COVID. Because going to trade shows to see what's out there, and seeing what's new, and what's coming out from people—we're not going to be able to do as much of that as we used to do.

Like I said, that multi-pronged approach is to look at other things, too. So, successful companies are talking to people in their supply chain. They're talking to their customers to see how they're running their operations. They're doing a lot of networking—the things that we do on LinkedIn, where we reach out to other people and we talk to them about what they're doing. Having good partnerships with your suppliers is also key. Getting access to what's new and emerging from them. Being able to see what's coming out. And I think just that general participation in your marketplace. That networking that you do to see what other people are doing.

Mike: So, Erik, once a company has gone through these steps and using this multi-faceted approach that you described, and they've decided on a new technology... Let's just use an example: automated vision inspection system to help reduce quality defects, or something like that. How do they integrate it in? Do they pilot? Do they just stop production and put it in? How do they get their technician workforce up to speed? How do they actually make it work?

Erik: Right. Right. Yeah. I think, again, I'll put in that plug that I mentioned earlier. The temptation that we have, especially as engineers and technicians, is to see a new, cool piece of technology. And then you start to walk around the production area and you're going, "Ok, what can I solve with this?" Unfortunately, that's the backwards approach.

So, it's starting from looking at some of the problems that you have. Evaluating those things. And this is where the technicians that are touching the machines day in and day out, the operators that are working with them, they're a prime source of finding those right opportunities. Addressing things that are a pain point. And when it comes from that person who has that daily hands-on experience with the system, THAT'S the gold mine right there. That's where you're going to get your best opportunities for improvement. So, as you identify those things, and once you find those technology solutions for it, I have a saying that I like to use with people is: "You think big, you start small, and then you scale up." So, you've got to have a good, clear vision of where you want to take things.

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Mike: What about upskilling the folks that got to work with this new technology? Let's talk about technicians in particular. How do companies typically do that? They send them out to vendor training. They do it internally. They work with outside providers. How does it work?

Erik: [laughing] I think it's "D) all of the above."

Mike: Oh, OK.

Erik: Any and every tool that you can bring to bear to help get people on the floor comfortable with the technology. Comfortable with the underlying principles. You made a good point earlier about for a technician to kind of understand what a particular sensor is. What it does. A little bit of the physics behind it. And why does it do what it does? Those technical skills are definitely important as we look to the future of the smart devices and the Internet of Things.

And one of the biggest things there from a hard skills standpoint is just learning some of those communications protocols. Learning how these devices talk to each other. And what's required from both the hardware and the software standpoint to get things set up and configured and talking to each other. And then how to troubleshoot when they're NOT talking to each other, what's going on there. That's one of the things we always talked about, the "goes into's" and the "goes outta's" on a device. What are the inputs? What are the outputs? What's the expecting?

So, really it's from the old days of measuring it with a voltmeter, to now looking at the communications protocols. It's really not that different. It's what is this device expecting to see? What's it actually seeing? And what's it gonna return? So, understanding those things is going to be critical.

Some of the other things that we need to look at as far as the skills that people will need is an understanding of the different types of sensors. Different types of devices that are out there. Understanding some computer skills. Being able to work with some of the apps that we see out there for helping to create processes out on the floor. Working with technologies like augmented and virtual reality, and 3D printing, and understanding what's behind those things.

Mike: Erik, those are interesting comments. As I reflect on what I know of manufacturing education programs around the

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country, mostly at community and technical colleges, they focus on helping prepare technicians to enter the workforce or to up-skill. I don't think many of them have in their coursework much on communication protocol of interconnected devices. Our listeners might be nodding their heads, or shaking their heads—one way or the other. But I think that's something where we could all pay a bit more attention to. Would you agree to that?

Erik: Absolutely. Absolutely. I mean, it's in the name, the "Internet of Things." The backbone of that is internet. Ethernet communications. So, understanding how these things communicate is going to be critical. To be able to walk up to a system, and diagnose: What's going on? Why is it not working the way it should?

Mike: A friend of mine in the manufacturing floor says, "Ahh, just call the IT department and let them manage it." I'm not sure that's the best answer here.

Erik: No. And that's something that we talk about a lot in this industry is: there's a need to kinda define those two worlds. So, when we talk about Industry 4.0 and the Internet of Things, there's a phrase out there where we talk about being at the convergence of IT and OT. So, that's your Internet Technology or your Information Technology. And then the OT is your Operational Technology.

Mike: Yes.

Erik: So, that's expanding beyond understanding "how the things communicate" to "what the devices are actually doing." What is a programmable logic controller? How does it work? How is it making decisions? How has it been configured? Even to things like a smart servo drive or a smart AC drive? These things have some intelligence in them. But at the end of the day, it's not just a computer, or a server, or a printer, or something like that on the network. It's something that's performing some advanced functionality. And without a full understanding of what that piece of equipment is doing—beyond just being able to connect to it and talk to it—you're really not going to be able to understand how to diagnose it and how to fix what's going on.

Mike: Would you say, and this will be my last question for today, would you say the technician really has a strong role here? I mean, it's not just engineers anymore. It's technicians, part of a team, that are talking about this

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convergence of IT and OT that you just mentioned. They really do have a role, don't they?

Erik: Absolutely. Absolutely. They're the frontline. They're the people that are out there—making sure everything is happening. On the case of a machine down or preventive situation, every minute counts. And every minute that you can save, instead of sitting there waiting for an engineer to come out and fix a problem or diagnose a problem. Every minute you can save by being able to work on these things "real time" is going to pay off. And the dividends will be huge. It's going to be a huge help to the company. And it's going to be a big feather in the cap of the technicians that can step up to that challenge.

And there's a mindset shift that needs to happen instead of just saying, "Well, this isn't my problem. The engineer needs to come fix it." It comes down to having a mindset of continuous improvement. Wanting to be able to make things better. And keep things moving smoothly. But then also stepping up those problem-solving skills. Doing some deeper dives into things. We talk about things like the "Five Whys" and "Root Cause Analysis." So, you dive into a problem. You keep asking "why?" until you get to that root issue, these are skills that are going to be absolutely essential for technicians to have to be successful, and add huge value to their companies, and make themselves really indispensable.

Mike: Erik you have given us some actionable items here to our listeners. For example, you just mentioned "Five Whys" and "Root Cause Analysis." That's so common in industry, and yet I'm not sure, again, that many of our manufacturing education programs... It might be mentioned, but do they really stress it? Maybe our listeners could say, all right, let's bring this into our projects. Let's talk about the Five Whys, how it works. Let's talk about doing a Root Cause Analysis here. I think that could help. From everything what you're saying, I think that could better prepare the technicians to enter this emerging workforce. Do you agree?

Erik: Absolutely. Yeah. I couldn't agree more.

Mike: I like it. All right. You know, Erik, I appreciate your thing today. I took a bunch of notes. I mean, I love the words that you talked about devices that are streaming actionable intelligence. And then the technician's role is

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to act on that intelligence, to interpret it, to understand it, to work in concert with the machines and making decisions. Those were good questions.

You're talking about that frontier, that convergence of IT (information technology) and operations technology (the OT). That's an interesting approach! I want to make sure we use that going forward. I'd like to quote you on that, if I could.

Erik: Absolutely. Yeah.

Mike: All right, Erik. Well, it's just great talking to you today. I appreciate all the time. Taking you out of your job. For all your insight and perspectives on advancing Industry 4.0, the industrial Internet of Things and all the things that go into that. Erik, I appreciate your time today. Thanks again.

Erik: I appreciate it. Thank you.

Mike: That's it for today, listeners. Today, we heard about a vision of connected manufacturing that has systems that can sense, analyze, and respond. Pretty cool! The blog posts written by Erik and his colleague has a lot of information on there. I put a link to that in the show notes. I encourage you to read it.

Here's your action for today, besides reading that blog post: take a look at the recent communication protocols that Erik mentioned in his blog posts. Make sure that you understand what they are. See if you can integrate them into your courses and your curricula. And finally, as the podcast wrapped up, you heard the talk about the convergence of OT (Operations Technology) and IT (Information Technology). I hear this a lot in our recent discussions. So, get yourself up to speed. I put a link to an interesting web-posted article about that convergence: that OT-IT convergence. So, take a look there. That's your action items.

As always find our podcasts on "preparingtechnicians.org" or subscribe on Apple podcast or Google Play. A rating and review is always appreciated. Our series is produced by John Chamberlain at CORD. Thank you, John. And the project is led by Principal Investigator Ann-Claire Anderson. Thank you, Ann-Claire. And thank you, our listeners for Preparing Technicians for the Future of Work!

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Lesiecki, Michael (Host). Preparing Technicians for the Future of Work Podcast: Episode 18, *It's All About Connected Devices* (audio podcast, transcript). Center for Occupational Research and Development, Waco, TX. December 2020. Retrieved from http://www.preparingtechnicians.org/

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