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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.

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So, joining me today in our discussion is Dr. Marilyn Barger. Marilyn is the Executive Director of FLATE. And that's part of the Florida Makes network. Welcome, Marilyn. Thank you for joining us today.

Marilyn: Thank you, Mike. Happy to be here.

Mike: Also joining us is Dr. Richard Gilbert. He's a professor at the University of South Florida. Richard, thank you for joining us today.

Richard: It is my pleasure. Thank you very much for entertaining this activity.

Mike: Great. You know, today with our two colleagues, we want to talk about a recent event that happened in Florida. They called it a "caucus around the future of work." They gathered manufacturers, industry members, educators, to talk about this vital topic, which you've heard us address many times on our podcast. We're going to talk today about the process they use to identify key things around the

Industry 4.0 initiative and what they did with those results.

Let's start with Marilyn. Marilyn, tell us a little bit about the caucus. How was it designed? And what were some of its key results?

Marilyn: Okay, thank you, Mike. Well, we started actually with a survey for industry and educators. And we took those results and then used the caucus, the virtual event, to have discussions around issues and gaps between the educators and the manufacturer's responses to that particular survey. It was all about skills and Industry 4.0. So, it was kind of a two-part process.

We started by identifying four of the technologies that are part of Industry 4.0, that would most impact manufacturing technicians—this was focused on manufacturing—in the next four to five years in their daily operational mode. So, although we know, for example, that cloud computing is considered part of Industry 4.0, it's not going to directly impact the technician who's troubleshooting equipment or running and operating machines or a line. We tried to focus on the four most impactful—that would happen the soonest—in a manufacturing environment. So, we did some research to identify those.

And the four that came up were around Autonomous Robots, Simulation, Industrial Internet of Things, and then a collection of Additive/Subtractive Manufacturing. But Materials kept coming up. So, we added that to that particular part of Industry 4.0 technology. So, it was Additive, Subtractive and Materials as a really important part of those two technologies.

Mike: Marilyn, was this an educator's perspective? Or a combination of industry and educator’s perspective?

Marilyn: It was a combination of both. We asked manufacturers. We did not do a formal survey. We did some conversations with a number of manufacturers and faculty in the two-year colleges. They were teaching in these areas. And also had some input from site visits that myself and others that we talked to had been on and just in the observational mode of what they were seeing in factories.

Mike: We're talking about 133 manufacturers responding, I think, here. So, it's a fairly large number!

Marilyn: Yeah. We had a good cross section from across Florida all over the state that responded to the survey.

Mike: Okay, excellent. So now you've got these four. What happened next?

Marilyn: So, what happened next was we developed the survey, a separate one for manufacturers and educators, just because some of that vocabulary is different. But we asked them the same question about the technologies. We defined a number of skill sets under each of those four topics. And put those in the survey and had them select the five most important or the five they would see coming up soonest in their facility across the state.

And for educators, the question was slightly different. It was more like, "Which are the top five that will be coming into your programs, if they're not already there, because of industry interest in those skills?" So, we did have separate surveys. And the idea was when we collected the data, that we would be able to compare the number of responses from manufacturers to the percentages of each of those skill areas and look for some gaps.

Mike: Where was the biggest gap you found? Let's go right to that "biggest gap." I'm just curious.

Marilyn: The biggest gap was a whopper! [laughing] It was on Simulation. As a matter of fact, it's an interesting technology. And the manufacturers said--like over 50% had that ranked in those top five or 50% of them selected that. And only 12% of the educators selected that as an "important technology" for their students.

Mike: That is a gap! Now, Marilyn, let me pause for a moment and turn to Richard.

Richard, from your view, not only the caucus itself, but your knowledge of this area, let's focus on simulation for a moment. What do you see as that gap? I mean, what is it that our technicians should be learning that they're not learning now? Which direction is Simulation taking us? I'm not phrasing that very well, but can you give us a sense of what it means to know and be able to do Simulation?

Richard: Yes, I think I can provide a few thoughts on this topic. One of the things I think we have to realize is that we are dealing with technicians. And technicians have been involved in manufacturing for a very, very long time as

technicians. Before that they probably might've been considered "operators" or something like that.

So, what's happening is that we've had a vocabulary adjustment over these...let's just define it as 50 years for the sake of a boundary condition. And that vocabulary adjustment has ended up where we are today with the word "simulations." So, that leads us to the issue of how does the simulation get involved with the technician's task? And what skills does the technician need for the simulation part of his efforts that are now part of the skills gap?

Perhaps what I can suggest to you is that the simulation concept actually was revolutionized by (what I would call) the removal of the human from the analog-to-digital conversion of the process-sensor measurements. Classically, you would have a technician looking at a piece of instrumentation. And it would be an analog meter of some sort. And there would be a message: "35 degrees centigrade," for example. Or "500 pounds per square inch." Some sort of sensor response.

Today, thanks to the Internet of Things driving force, that has changed dramatically because we have digital technologies that can do the analog-to-digital conversion. So, the human being does not have to be in the middle of that recording and data-storage activity. So, the Internet of Things is basically, from a fundamental perspective, the equipment and manufacturing version of Internet of Things, is equipment that is, in fact, able to interact with other equipment and human beings without having the human being in the middle.

So, the new skill for the technician, won't be, "What do I do with the temperature being too high? Or the pressure being too low?" Those types of skills are already within the technician's skill base. What WILL be a question is "How much of this interaction with the Internet of Things at this computer-interface level does the manufacturing technician need to know?"

So, that's at least one particular use of simulation as it evolved relative to the Internet of Things. And if there's time, we can discuss how it connects some of our other topics as well.

Mike: Good, Richard. Thanks. Marilyn, Richard just mentioned "Internet of Things." In your work, you identified "Industrial Internet of Things" as one of these key four

topics that we've talked about. From your perspective, just like I asked Richard, what do you see as emerging in that area? What's emerging for Industrial Internet of Things that our technicians are going to have to do and have to know, which they might not be doing and might not know today?

Marilyn: On this particular question, the responses came back with the educators having a high response rate and the industry responses, not so much. So, maybe a little more than half I would say. And it was related to very specifically—remember, I said there were a number of skills under each of those technologies—and this particular one had a big gap where the educators were higher. But it was focused on "Record and Store Data." So, I think this goes directly to one of the other Industry 4.0 technologies—which deals with big data or data science, different people call it by different names. So how much will the technicians really need to know? How much more will they be involved with data that's coming into them from the equipment through various interfaces? As more machines talk to each other, the data they'll be given from the processes will start to change because individual machines may not produce some data. They may be a collection of machines that are producing. And analysis will come out with different parameters and they've dealt with in the past.

So, that recording the right data, understanding what data they need when it's coming at you faster and more furiously than it has in the past, from more directions, I think is the piece that educators are a little worried about because Recording and Measurements has always been a place where we've had to focus to bring technicians up to speed. Some of those math skills, for example, will become much more important and the analytical skills to deal with the data.

Mike: Very interesting thinking about what you're seeing from both of your perspectives, what's emerging. You have a good, strong knowledge of industry and the education side.

Let me turn back to Richard. Richard, another topic that emerged was Autonomous Robots. As you think about that, what aspects of that...? I mean, don't the technicians just get out of the way and let the robots do their thing? But what have you seen that a technician will need to know and be able to do that's now emerging in that field?

Richard: That's absolutely correct about robots. And now let's include "co-robots" as well. And what the expectations of the technician were and are. Well, it used to be, as you said, because robots could only do single—and I'll say this with some respect—stupid tasks. Sometimes those stupid tests are humongous, but they could do just stupid tasks. The only thing we wanted the technician and the operators to do was get out of the way of the robot. And we did that either by confining the robot or we confined the people.

So, that's not going to be happening anymore. And what is going to happen there is the use (and more clever use) of the Human-Machine Interface. And those types of devices will allow the technician and the operators--because operators are going to start moving up in their expectations as being the technician skills as well--to interact with the robotic systems and put everybody into a smarter situation.

So, what's going to be happening there is: the programming and system integration activities associated with robots and co-robots. And the issues there are, what are the new skills the technician needs to make that effective.

There is always this common thought that new employees and the younger generation is going to find this easy because they already know how to do four or five things on their iPads or their phone communication devices. But that isn't quite the same expectation of a technician interacting with a HMI (a human machine interface tablet) with a robotic system. It's not a casual interaction. It has to be a focused and intense communication with expectations of the human being, paying a lot of attention because the robot still will just respond to the information it gets from the interface.

Mike: Good. Excellent definition there, Richard, thank you. Let's turn to that fourth topic—back to Marilyn. Marilyn, you said you had a catch-all term, which was "additive manufacturing, subtractive, and some materials." What do you see as emerging? Does a technician today have to be able to manufacture a part using 3D printing? Or do they just have to know what it is? What did you find in your own observations and from your caucus? What highlights this area of Additive/Subtractive and Materials?

Marilyn: Well, I think in this particular area, the responses were pretty similar between the two groups. So I'll just

put that out there as a factoid on this. Both of them are between 35 and 50% responses from both groups. So, they were kind of, I would say "On Track" compared to some of the others that we talked about. I think what was important is a lot of CAD, drawing, reading prints, being able to prototype... The comments that we got during the discussions were a balance of those areas. So, thinking out loud, it's the technician role of taking what they know from operations into troubleshooting, new product development, root cause analysis,...those kinds of things, where they need their information about how to fabricate things, either additive and subtractive. So, they probably need experience in those, with whatever is used in their particular facility, so they can understand the process and be able to improve it.

So, I do want to go back just for a moment to the Simulation. There was one observation that came out of the survey results. So, we did this comparison between manufacturers and educators, and the percentages of the responses for each. And under Simulation, we had five separate skillsets. So, one was a work on root cause analysis, participate in planning and evaluation processes, compare and contrast alternatives, recommend the new situations and their effects on processes, participate in developing existing and new products. So, those five skill sets (or different task areas) were chosen by manufacturers more times than educators. All of those under simulation were higher from manufacturers. So, I interpret that grouping——Those were the only ones that were higher. And that their expectation of higher-level thinking skills, and critical thinking, trouble shooting, problem solving, and having the tools to do that have escalated in importance. So, using their technology (familiarity and knowledge) and being able to use it in those problem solving activities and the variety of ways that I just listed.

Mike: I think you're making a good point. You mentioned, just as an example, "Perform root cause analysis." I'm not sure that's something that technicians are so used to do today, but boy, in the future, I think that's going to be different as your results have shown.

Marilyn: Well, I'll just put a qualifier on that. It became important in the responses during the caucus that they be part of the team and they served as the subject matter expert on the equipment. So, working with planning and

product development teams, which may be more engineers, that it was really important to have those people that are on the ground floor as part of that team and providing, "Oh, you can't do that that way, it'll never work!" The paper to the actual situation, the actual equipment.

Mike: So, Marilyn, as we wrap up today, as you think back on this caucus, you really gathered together manufacturers, industry members, educators in the state of Florida, you focused on the future of work, the emerging technician skills. You identified these four major areas and broke it down into the emerging skills. What do you think as you look back on it, what was the main thing that really came out of the caucus? And I'll ask Richard that same question. But let's start with you, Marilyn. What really stood out for you? That came out of this caucus that was held just in the month of October, just last month.

Marilyn: I think the conversations were pretty rich and pretty specific when we had the people together. And a lot of the responses we got during the discussion part, just emphasize that they were talking about the same things. A lot of times there was some of the very same vocabulary for particular items. So, I thought there was really good communications. So, we have to dig a little deeper into those gaps, but there was pretty good understanding between the two groups as to the skill sets that a technician today needed and would need to use.

Now, we're going to take what we've got and do some work with, "Are there things that are missing in our education programs that we need to start thinking about adding? That will be the next step for this particular project and having a good foundation that we're talking to mostly the same language will be a good start for that.

Mike: So, making that foundation for moving forward. Boy, that really, that makes a lot of sense to me. I was glad that you were able to do that. Richard let's turn to you. What was your takeaway? What really struck you from that caucus in October?

Richard: The absolute striking component for me was the almost identical characteristics of the skills gap problem in each of the areas that manufacturers were interested in--the developing of existing and new products. They're interested in recording and storage of data. They're interested in programming and system integration. They're interested in

fabrication. And the other one that was phrased, it was root cause analysis, which is a topic we've come back on a couple of times today. So the striking thing there is we have to work on the vocabulary adjustment. And there is a different perspective of the skills based on that vocabulary adjustment. And therefore the skills gap shrinking will only happen when we can get both sides to appreciate the similarities.

Mike: Sure. Thank you, Richard. Good comment on that. Let's ask Marilyn for the final thought for today. Marilyn, I'm just going to throw this one at you. What's our best approach to shrinking this skill gap, going forward?

Marilyn: More conversations with the industry and educators! I think it's important for us to continue to have conversations like this so we can meet these "vocabulary gaps"—if that's what they are—and that represents skills gaps, and we meet them head on so they understand the new technologies that are coming out and we use the same terms to describe them.

One more comment on the whole project here. I think we learned that all the skills that came out of this, that were identified and talked about—there were not a lot of the foundational specific technical skills, like "I know how to operate this motor." "I know how to wire this machine." "I know how to program this PLC." The concerns or the specific skills were at a higher level. And the technical skills of the technician are just an expected skillset that they can do that. And they are now required to use those skills to work more closely with the global environment of the facility that they're working in.

Mike: Excellent. And thank you for that comment.

Marilyn and Richard, that concludes our discussion today. You know, as I reflect on our own project, Preparing Technicians for the Future of Work, and look at what you've done in Florida with your manufacturing network, with your educators, I think you're really giving us a model of how to advance this: how to identify the skills, how to look at things like Autonomous Robotics, Simulation, Industrial Internet of Things, Additive, Manufacturing Materials. Those are the key things that you have identified in going forward. Ultimately, that's going to increase the availability of the skilled technical workforce and make our economy and our industries more competitive.

I know I'm waving the flag there a little bit, but thank you again for telling us about this caucus that happened in Florida just last month and illustrating your key findings there. Appreciate it! So, Marilyn, thank you. Richard, thank you.

Richard: You're welcome.

Marilyn: Thank you so much. And you're welcome.

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Mike: That's it for today, listeners, you heard Richard and Marilyn discuss those nine technologies that are shaping Industry 4.0. In the Show Notes, I've linked an article that shows a figure of those nine technologies. Here's your action for today. Take that figure to your next industry Advisory Board Meeting or send it to your industry Advisory Group. Ask them to help you identify the top three or four out of the nine that are important in your region, in your industry sectors. And then drill down with them to see what specific skills they feel are the most needed. Then you're going to carefully look at your own programs, your own curricular, your own courses, and see what changes YOU might make to keep pace with the future of work.

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