[music]

Todd: So, just look at the data. Software will continue to fuel more powerful AI. And so, we need to be aware of that and need to get young people attuned to that notion more than ever.

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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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Our guest today is Todd Christenson. Currently, he's the Chief Technical Officer at HT Micro. That's a company that specializes in microelectromechanical systems. And it's a company he founded about 20 years ago. But Todd also has other interests. For years, he acted as the president of the MANCEF organization. And that's the Micro and Nanotechnology Commercialization Education Foundation. So, you can see his interests are on the commercialization side. But I know Todd. And I know that he's been involved with education for a long time. He's very supportive, can be a very strong mentor for students, and has really a good sense of what's going on in the pulse of this technology-industry segment. Todd, welcome to the podcast. Tell us a bit about what you're doing today. Let's hear what's going on with you.

Todd: It's really a pleasure, Mike. Thank you for inviting me. Today we see build out of an area that I was attracted to from the sensor realm early on. And I would say the general human-machine interface is being perfected. As you've seen Mike, and I know you've been involved in looking into micro sensors (or what's called MEMS today, as well), that this field has really matured.

Mike: You know, in that field, Todd, what does a technician do? Suppose a technician is working in semiconductor manufacturing? Or MEMS systems? Or electronics? What actually does a technician do today?

Todd: The field of integrated electronics has now evolved to include sensors. And today most sensors are fabricated with tools used also to make chips (integrated circuits). So, I'll speak to both of those, because I think there's a lot of commonality that exists, even though my background is largely in MEMS (integrated sensors).

The tools used to make these devices are extraordinarily complex tools. They need troubleshooting—all the time. They need maintenance—all the time. They need monitoring. And what I often look for, in developing a good technological awareness of fabrication, is often called "a good eye." You sort of accumulate this with experience.

But what you want to know is, "Is this equipment behaving in spec?" Then ultimately, "Does it need more monitoring?" It runs the gamut from running the tool, to running the process, as well as testing the device. Does that make sense with what you've seen?

Mike: You know, it does! I like that term "an eye" or "a sense" for when things are working, or when they're not working. That's not so easy to get!

You think about the workforce that you see out there, Todd, all the different companies you've been involved with. I'm sure you have a sense of potentially what skill gaps might exist, right? There's a new employee, let's say, comes in—first six months on the job. And people are scratching their head saying, "Why doesn't this person know more about this? Or more about that?" What skill gaps do you see? I'm talking mostly about the technical skills, Todd. What's your sense of that?

Todd: The skills run the gamut from mechanical to thermal. Electrical. Environment. Clearly Aging, today, is a critical piece of making good product and understanding what that is.

People think often that the computer is making all our lives easier. Well, from a technician standpoint, I'm afraid digitization has made their role even more challenging. Not necessarily easier. Because one needs to understand troubleshooting the digital realm, as well as troubleshooting the device you're making—even if that product is software.

I guess I was lucky. Early on in my career... I'll just share a couple of stories if that's okay.

Mike: Sure! Sure! Go ahead!

Todd: I had a grandfather who repaired televisions. And in the day, it was okay, if the TV was too far gone, or the radio, or frankly, whatever the electrical device was—it ended up in the dump. And he had a—well, I'll call it—a "TV dump." This had every kind of TV you could imagine in the day. And this was tubes, and kind of at the dawn of transistors.

And basically, he said, "Go. You can have anything you want in there. But you got to fix it. Make it work." I couldn't. And so, I had an immediate mentor. And I had immediate hands-on, real-world practical know-how! I wish everybody could have a "TV dump," right?

And you've probably seen some of these older pieces of equipment. They often have multiple tiers of engineering involved in them. So, there's no software defined user interface, in the day, right? But there were some creative ones. Creative mechanical ones. Creative electronic ones. Ultrasonic remote controls were used! So, this was just happenstance.

I was lucky to be involved in a company that was early in cellular radio. And talk about what experiences technicians can have. Or what kind of things they developed to be extremely useful for making a successful product. And I learned one there that still sticks with me today!

When the cellular radio network was set up, we used to go around... And my colleague actually ran a van around (This is in southern Minnesota.) with an Apple II sittin' in the back taking radio-signal data. And he would come back. And the engineers would look over the data. And it was evident

that the signal was dropping. And he'd come back, and say "You know? It's dropping more than it did last week. And what the heck's happenin? Did you calibrate this...? And then a tech who was setting this stuff up said, "Well, you know, there's a big change occurring in the environment." "What's that?" Well, he was a farmer. He said, "Well, the corn is growing!"

Mike: Ach! That's funny!

Todd: Sure enough! You could see the signal dropping as the corn was growing! And, you know, the engineer response, by the way is, "Oh, maybe we could measure corn height with this." No, no, no! That's the wrong answer! You need to go back and change your power budget. [Mike: Yeah.] So, as you know, practical know-how is everything.

Mike: So, that's interesting. So, it can't be easy, right? For someone that's new, working in a technology environment doesn't always have that practical know-how. And yet the community colleges and technical college that we have been involved with, they try as much as they can to build in that hands-on stuff.

And that leads me to this question, Todd. I know you've been involved with educators for a long time. And they often ask you, how are our programs? How should we adjust them? How can we make sure that they're aligned with industry? So, I bet people like you are quite willing to tell them what is current, what it should be. But here's the funny question, Todd: Do they listen? Do they like being told by industry what to do? Are they're willing to take that advice? What's your sense there? What's your experience?

Todd: I find it's a mixed bag. Everybody realizes that for education to provide the skills that are needed in the workforce, you have to have a little more cross-disciplinary flexibility.

In the case of sensors... And sensors, I would claim, is an area that the economy is becoming based on. I daresay, by the way, almost every startup or commercialization activity is often enabled—if not substantially benefiting from—a sense that you can take autonomous, you can take drones, you can look at all these emerging areas, and they're at the forefront of what's new. In fact, I call these new companies often "sensor enabled software startups." Ultimately, they wouldn't be a company if they didn't have

a sensor. But what they do spend 90% of their time on is developing software.

So, mentioning this to educators today, I think they know it. What I try to do is help them see examples of how impactful it is if a new hire has these skills, versus if they don't. Because then they struggle. And then they can become dejected. And just not interested. And that doesn't serve anybody well. So "hands-on" is critical. In fact, what I advocate is "just go start taking things apart!" Even if they're the test equipment in the community college. Right?

Mike: Right. So, I see Todd. You don't subscribe to this thing: "If it ain't broke, don't fix it."

Todd: [laughing] Well, I would say, "Go break things. But fix them!"

Mike: Okay! Okay! Hey, I found it interesting: you've talked about digitalization and these cross disciplinary skills. That's really important to our project, you know, "Preparing Technicians for the Future of Work."

What about things like, you mentioned, cybersecurity? What about data science? IT skills? How much do these technicians need to know before they come into the workplace? Or how much will they pick up there? I know, that's somewhat of a vague question. But what about those cross-disciplinary skills you mentioned? Is it a "have to have?" A "nice to have?" Or "I'll get it someday?"

Todd: Yeah. This is an important issue today. I guess the way I would couch this is "It's all part of a debugging tool set that you need to develop." And, you know, if your data is being compromised, because the sensor's bad—that's one thing. If it's being compromised, because it's being written in the wrong file format—quite another! [Mike: Yeah.] At the end of the day, you want clean data and reliable data.

So, I think what you see, and I'm sure you've seen different curricula to address this (and it's a struggle, because clearly, one can't cover everything), I think if it's couched in the terms of "debugging approach," ultimately, this is what's most useful today. Lines stop—because maybe there's a misinterpretation of the data. Maybe there's just something that mechanically is broken.

At the end of the day, it's part of a debugging toolkit that you develop a toolbox around. And just like any toolbox, you have the most used items on the top there, and you can easily access them. And then if you have to dig, well, you know where they are! You just have to dig a little bit! And, if they're digital, there are certain aspects to a generalized debugging/fixing approach that you develop and have to hone. And that involves computer skills. And digital skills, as well.

Mike: Todd, we've talked a lot about people that are coming into the workforce. But what have you seen, in the companies you've dealt with: current employees, right? And things are changing fast. How do those current employees keep up? I mean, just look at the huge trends in automation and robotics. How does an existing tech, who may not be familiar with these things...how do they keep up with that?! Or any new emerging skill? What do they do? Do they use vendor training? Do they send them to a community college? How does it work?

Todd: Yeah, we do a combination of things. I think the most successful technicians that come into our facility have had good mentoring. That's one. And so, they retain a mentoring relationship. We often nurture that, as well. And if anybody wants to take a course, in our facility, they're welcome to do it.

But I think there's a couple of ways that are good. One is: send your technicians to trade shows. It's amazing. Once you get outside the realm of your fab or your facility, and you see what's emerging, what new tools are becoming available, what other technicians are using, how much you start to get in tune with what's happening in the real world.

The other one, you know this, Mike, I think, well: what NSF is doing today with their ATE community and Centers across the nation. So, I just advocate becoming familiar with the NSF ATE network, and see what the new course offerings are. If you're interested in something, the good thing about digitization is that you can usually interact online.

Mike: That's a good point. In fact, in our Show Notes, I'm gonna put a link to the Micro Nanotechnology Education Center, one of the ones you just referred to, so that people can access some of those things.

Todd: I see MNTEC growing—maybe faster than any of the Centers, at this point [Mike: Yeah.] given what's happening lately.

Mike: A little bit off topic here, but right about this time, we just heard about the new Chip bill that's coming up in Congress and all that. That's gonna make a big change, I think! There's a lot more resources being put into, not only R&D, but workforce as well. Is that true?

Todd: Well, this is probably an attitude that my engineering colleagues want to shift maybe entirely. You know, the money that's being allocated in the Chips Act looks like a lot. In terms of IC R&D, it's, quite frankly, a drop in the bucket. But if it was to be used largely, maybe even solely for educational purposes, I think it would have the biggest impact. And let me describe why.

You know, if you could simply give all elementary children (I don't know how many there are. 50 million in the US?) [Mike: Yeah.] You know, simply give them a microscope. Or a loop, an eye-loop, you know. And a telescope, you know, to get them more familiar with science and technology at a different scale than what we're used to. Boy, would that have an impact! And particularly at the community college level, where overhead rates are still low. They're not as gigantic as... I don't know what you're seeing in four year and colleges. But to me, it's out of hand. These overheads are dissuading good educators from participating, frankly, and bringing in grant dollars. So, I think this will have a big impact, if it goes to educating technicians in the country. Because this is a huge problem today: getting good technician workforce setup. So, my hope is it'll foster that interest, largely.

Mike: Todd, let me do one last question today. It means getting out your crystal ball, right? Now put on your technology hat, because I want to talk about the technology side. What do you see evolving or changing in the next few years? Maybe it's sort of trite to say, "What's the next big thing?" But where do you see technology going in this industry segment? And on the second part of that question is, "What advice might you have for educators that will help them prepare their students for these emerging things?" And those are two big questions. So, what are your thoughts there?

Todd: Well, software for sure is going to be a larger part of tech base. Marc Andreessen was right: "Software is eating the world." And I think it's something like 70% of the world's GDP now is affected by digitization. That's only going to increase.

Educators have to realize this is an exponential process. It's not a linear one. I think something like 50 zettabytes of data exists in the world today. That's 50 times 10 to the 21st power! But what's even more amazing to me is the growth rate! We're adding something to the tune of 1 zettabyte per week! (Rough, order of magnitude, right?) And this is growing! It's accelerating! It's fed a lot by education. The fact that there's cross fertilization of all of these technologies. So, just look at the data. Software will continue to fuel more powerful AI. And so, we need to be aware of that. And need to get young people attuned to that notion—more than ever.

I guess there are two main points, let's say, that rang true when I think about the technical workforce. And that's a) Try to find a mentor that has skills that you'd like to have. And b) just start taking things apart and putting them back together and making them work. And that's just not your toaster oven. That's the things you stick in your ear, and small electronics.

Do you want to know what's emerging in the market? Just look at your mobile phone. It's an amazing thing. [Mike: It is.] It's getting harder to take apart. But that's part of the puzzle here, right? And so, to the extent that educators realize that we're entering a significant period of disruption—and education is going to be part of that disruption—I think that will help them align young minds with the challenges that are emerging today.

Mike: That's good advice, Todd. You know, I was reflecting back on some of the things you said. For example, you just mentioned "mentoring." Again, that's a key thing. It's one that's not often thought about.

And also you said today, it's important for a technician to "have a good eye."

And I like that term you use: "developing their own toolbox" of things that they know how to do. Know how to use. I think that's a good approach to doing it.

Todd, I really appreciate your comments today, also talking a little bit about the Chip Act. And some of your thoughts about that. Very informative!

And again, in our Show Notes, I'm going to put a link to the Micro Nanotechnology Education Center (MNTEC), and some other links as well. So, Todd, just great talking to you about all of these things and hearing your perspective.

Todd: It's an absolute pleasure, Mike, and I hope you'll continue and build this out. This is a valuable resource. I'm going to point all my technologists here as well.

Mike: I like the sound of that! "Point" away! Okay, thank you very much, Todd!

Todd: Thank you, Mike.

Mike: Listeners, today we heard Todd talk about the need for skilled technicians, particularly those with digital skills and troubleshooting skills. We appreciated his reinforcement of that important message.

Also in the podcast, we talked about the Chips for America Act, signed recently (in August 2022). Get yourself up to speed on that Act. I put some links in the Show Notes. It will be important not only for semiconductor programs, but all technology programs that contribute to preparing the workforce working in that large industry segment.

Also today, I wanted to acknowledge the great service provided by our Audio Engineer, John Chamberlain. He does a great job of producing these podcasts. And thank you, John. Also, Ann-Claire Anderson, who is the Principal Investigator of our project. Thank you, Ann-Claire. And thank you, our listeners, for ***Preparing Technicians for the Future of Work!***

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