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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. 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 Eric Wooldridge. Eric's an Engineer, Architect, Associate Professor at Somerset Community College, a Farmer, a Technologist, a 3D-Printing Specialist, and on his website, he calls himself an Additive Manufacturing Guru. There's no pressure there, Eric, for that "guru" word. [laughing] But welcome to the podcast today.

Eric: Thank you for having me, of course. And that's what we call our YouTube channel: the Additive Guru. So, I get to spread that across multiple people. But yes!

Mike: Tell us a little bit about your background and the various things that you do, Eric!

Eric: So, we're at Somerset Community College. But we're actually part of a larger entity. It's actually the

Community College System for the state of Kentucky. And that encompasses 16 college sites and their satellites.

And our responsibility at the AMC (or the Additive Manufacturing Center) is to prepare the content material, the research, the courses, and distribute that across the entire system. So, we're responsible for the additive manufacturing/3D-printing curriculum that goes out across the entire state. It is sometimes a daunting challenge, for sure. But it's very exciting in the fact that we could be at the front line and pushing out material. So, that's one aspect of what we do.

My background is actually, as you said, Engineering. I'm a Professional Engineer, and a registered Architect. I did sort of a Masters work in additive, and Manufacturing Engineering. So, it's really exciting to be a part of this type of technology because it encompasses so much of my own personal history. Working on the farm, using 3D printers, literally, to print products that we can use on the farm.

Small business applications. Entrepreneurship. It's a extremely cool time to be doing this. And something that I'm very passionate about and love, of course, along with my private engineering work, too. So, it's a real blessing to be able to talk about what we do at the AMC and also kind of share this with the rest of the world.

Mike: Perfect, Eric. It's just great having you on the podcast today. If you look at, let's say the range of technologies that encompass Industry 4.0, additive manufacturing is one of the big ones that's listed there. So, when you think about that, what do you see—in a technology sense—that's emerging for additive?

Eric: Well, that's pretty big question. One of the things that I often say about additive, and 3D-printing in general, is that it's actually not about the 3D printer. The technology as we have seen (in terms of the equipment) just continuously gets better and better. Smarter and smarter. Every four, six months, you see some kind of new innovation that is now being integrated, even on the low-cost additive manufacturing equipment.

Our big focus (and especially with Industry 4.0) is the mentality. Because additive, as part of this new world of manufacturing, new world of supply chain risks—which we are

experiencing right now—it's all about how do you think through using this technology in a way that is different and better? For example, additive can create complex geometries that were pretty much unheard of in conventional manufacturing.

Additive is the answer to all the manufacturers, when an engineer would come up with this wild and crazy design and say, "Okay, this is the best solution." But manufacturers would turn around and say, "That's great, but we can't actually make it." Additive doesn't say that. Additive says, "Okay." And that's a completely new mindset, because we've always been worried about what we could actually make. And now we have a technology that will make it as we design. So, the concept of needing a blueprint, perhaps, is not there anymore, because you can just go straight from 3D model to production.

The concept of being able to iterate your design while IN SERIES PRODUCTION, that's completely foreign! No product previously has been able to update itself WHILE IN SERIAL PRODUCTION , and going to consumers. It's always been, "OK, we're going to roll out a new product next year, or maybe a year and a half from now." So, iterating, the product is a completely new concept. The ability (the fact that generative design can be used with additive) to create next-generation-level designs that we couldn't even fathom on our own is part of additive.

So, there's this whole new mentality that is the real focus here. Moreso than just the equipment, it is, "How do you really bend this technology in the best possible way to suit your needs?"

Mike: You know, Eric, that's a perfect lead to this question. When you think about technicians, right, "What skills do they need?" Suppose they emerge out of a KC-TCS program out of your AMC program into the workforce. What skills are you sensing that industry needs for them to have an additive framework?

Eric: Ahh, that's an excellent question! And the problem in answering that question is that "It all depends."

We talk about this technology being utilized with companies at your high-end level automotive manufacturers. The same technology is being utilized by small mom-and-pop shops.

So, the "skill requests" from these employers is very, very different. I'll have one company who wants "a person who can do it all." They can design. They can print. They can do post processing that understands the materials. They want to like "hire a one-stop-shop person." And then another company will say, "Well, we just need someone to run the equipment. To keep the logistics handled, the materials flowing. And just keep our products coming through, because we're a "service bureau." So, it's a lot of different mindsets that are associated with this.

So, in terms of what the skills needed, that's what it boils down to. It is we have to cover almost all the skill sets, but in a way that will allow a student to adapt themselves to their employer's needs.

Now, therefore, it's a pretty intense program. We have to build in enough design mentality using your parametric modeling software, your generative design, such as we use with Autodesk Fusion 360 (which has been a great supporter of our projects all across the state), and build that in. But then turn around also train them on normal operations, such as tracking materials and processes with Excel spreadsheet formats.

Understanding like "how important a spreadsheet is." And keeping your supply chain going. And tracking that data. So, it's a wide range of skills, that we had to find a way to incorporate into a certificate program, so they can go to work for the mom-and-pop operator. Or the major automotive supplier. Or maybe Department of Defense contractor. All of them are integrating additive and meeting their needs is sometimes tricky.

Mike: You do this all in 18 credit hours?

Eric: 16, actually! 16! Now you can take eight. We have no problem if you want to take an extra class.

Mike: Yeah, sure.

Eric: Our first certificate out can come out at 16.

Mike: You know, I'm going to put a link in the Show Notes to that certificate at your college, because it's interesting the way that you've laid it out. And I think other people listening here will want to look at that as a potential model.

Here's another question. You know, I was thinking, if I go into indeed (indeed.com) or one of the job-posting places, and I type in "additive manufacturing technologist," I don't get many hits. It's not really a job posting sort of thing. Is it bundled into other stuff? Where does it lie? Do you know what I mean?

Eric: Oh, THAT is a great question. And it's true. If you go on, in just one phrase, you're probably not going to get that many hits. But then, you find out, if you type in a slightly different phrase, such as "additive manufacturing technician," "3D printing technician," "CAD modeler," "rapid prototyping," "design modeler," what you're going to see is that all of these different terms... Because, you have to keep in mind, especially on indeed.com, these postings are generally put out by HR departments. They're generally not put out by the person who's got the boots on the ground and knows exactly what they're looking for. Sometimes these positions are "coded" a certain way that a company is always used to coding it. And so, a person who wants to look at the job openings has to have a very broad spectrum of keywords that they're using.

Almost all of these companies are going to involve some CAD. And that's one of the things that we built into our program—is that there is a heavy interest and focus on parametric modeling, because that's crucial to additive, but it's also crucial to everything else. So, a person can actually go to a wide variety of jobs, taking additive with them, but still be qualified to do something, let's say in the machine tool, because there's additive techniques for machine tool engineering just as much as anything else. So, it's important when doing job searches, not to limit that terminology.

And it's also important to realize that all of these industries are integrated additive. Case in point: there are dental offices hiring folks who have additive experience. Why? Because they're 3D printing dental components right there in the office. And that's not your normal manufacturing mentality. We don't normally send our welders to dentist's office! We don't normally send our CAD modelers to dentist's offices! But that does show that there is the opportunity for a job at that dentist's office, even though they may be posting position for a dental technician.

Mike: Sure. You know, Eric, I think one of the barriers—as I talk with people around the country—to bringing more additive in is that "design" question, right? How much does a technician really do in the design? I mean, they need to be able to manage the files, and things like that. But do they actually sit down with something like SolidWorks, or Fusion 360, or whatever you might use? Are they tasked with designing parts? Or rather handling the files from designers? I'm not sure I'm phrasing that correctly. But where did their skills lie here?

Eric: That actually goes back to that other point that I made. Is that: we have to keep in mind that a huge part of the American industry is NOT the big corporations. It's the small operators who are working FOR the big operations. Your tier-two, tier-three, tier-four folks in supply chain are using the same technology. And so, when they come looking for a new hire, they will want someone who can do the design work, in addition to the manufacturing work, and handling the files, and everything else.

Case in point for Kentucky: one of the things that surprises folks a lot about this particular state is that our major export (to a tune of a factor of about 3 or 4, and in the "billions!") is aerospace manufacturing. No one thinks about Kentucky as an aerospace type of entity. That's more of a west-coast/east-coast type of thing. But yet, it is our biggest export over automotive by a significant degree. Yet, the actual people doing the work are small business operators working to produce aerospace products. And what they're interested in, of course, is file management. But they're also interested in expanding their product lines beyond aerospace. And so, what they want are design technicians. So, they want it all!

And so, there's the challenge. That folks who are in this field, in industry, you really have to consider the fact that you have some of your main companies that hire the people. But that you may be "leaving opportunities on the table" for students by not engaging your small businesses and your entrepreneurs enough to say, "Well, you're going to introduce this new product. You're going to need one of my students. You're going to need one of our other folks."

And here's also sort of the weird phenomenon... It's not really weird. But it's something to consider. One of the

reasons additive doesn't have a tremendous amount of acknowledgment or feedback from industry is because it's an emerging technology that they have realized, is giving them a competitive advantage. I mean, we quite literally have companies that will HIDE the fact they're doing additive in-house. Obviously, NDAs and agreements can handle that. But that's the mentality—is that additive is so advantageous, that they will not talk about it with others.

And so, which makes it hard for an institution, university or college to say, "Okay, this is what we need to guide our students into, because this is what industry is telling us." When industry is NOT talking at all about this. So now, plenty are, for sure. And you're going to see more, as it becomes more aware of what's going on, they start to acknowledge things. But right now, because of the advances of additive, you're seeing a lot of proprietary secrecy around what they're doing. And also, the skills that they want to do it with.

It really took a learning curve for us to figure out the right way to address all of this. And we had to step away from the mindset of an educator—to the mindset of an employer, to the mindset of a business. And we had to learn to think more like them and the industry, and then bring education to that mindset, instead of the other way around. We had to think first like a company, and then how to educate in that direction. And so, it makes total sense when we think about it now.

And so, we sit back, and we think, "OK, if I'm starting a business that is such and such size, what is the basic elements of a technician that I need to pay for, and get the most profit out of?

Mike: Sure.

Eric: And when you work from that mentality, and you work out from that mentality, that's when you start to create a curriculum and a product, if you will, from the educational standpoint, that a company (who is that company that you've designed for!) is going to like. They may not even realize they're going to like it—until you introduce it to them.

So, it's partly we had to build both the educational workforce and the industry awareness at the same time. Which is part of the challenge. But over time, and a lot of

diligence, has turned out to be a very productive side of things for us.

Mike: You know, Eric, thinking about that certificate that you offer and the way you prepare students... Think about the processing side now. Do you give your students knowledge and skills in all of the different process technologies—SLA, FDM, maybe even metal—or do you try to have them really be skilled in, let's say, fused deposition, and a brief knowledge of the other technologies? How do you balance? There's a lot of different stuff out there. How do you balance that?

Eric: That's an excellent question. First thing, like most anyone, we would introduce the broad spectrum of, like: these are the technologies at the very, very low level. This is how they work. This is the differences. And then we would focus on design, mentality, product flow, slicing, everything. And obviously FDM. Because we do have a tendency to focus on low cost first.

The only way to get, not only the students trained effectively, but also the industry to integrate the technology, is you have to give it to them in terms of "low-cost equipment." I don't want someone who has a business, go out and buy a $250,000 machine, and get started with that. That is a really bad decision. We want them to start off small and build up. And so, our students will work with FDM low cost. They'll work with SLA low cost. We will actually have some SLM applications that are considerably low cost. And then we advance them on up to your higher costs SLM.

Also, your "bound metal" is a great application. It's low-cost equipment. It's a little bit higher cost on the materials, but we can get him into that. And then also working with some of the medium range equipment, too.

So, we do a lot of FDM. We do a lot of SLA. And some SLM. And the combination of those three, not only builds in enough mentality and gives them enough hands-on experience, but also sets them up well to go out and produce with that. Or adapt to other technologies and equipment. We lay that foundation and give them enough comfort level with it. It makes it very easy with a little bit of training to jump into something else.

Mike: I like that approach. It makes a lot of sense, Eric. And I can't help following up with you on metal. You mentioned bound metal. Is it real? Is it "real" in industry yet? Is it still just a phenomenon?

I remember holding my first metal printed thing at a college up in New York. They printed the FDM version of it, and then the desktop metal version of it. And I was impressed—just at the density, and things like that. But that was more phenomenological than anything else. Is it real today? What's your thoughts?

Eric: First thing I want to distinguish a little bit in terms of the metal additive. Because metal additive is already "a thing" in industry. Now powder-based is the more accepted approach in terms of industry because it's been out longer. It's more mature. There's more ASTM standards around all of this stuff. And so, that's already happened. That's already a part of industry. It's already ongoing. It's there. The bound metal is the new entry into it. And this same thing is happening. You are seeing folks go out and buy equipment that can do this, and start playing with it.

Right before COVID, we actually did what we consider like the first example of low-cost bound metal fully welded together. And it worked! In fact, the welding was really, really good. So, it proved that the technology was good enough to weld together. Which means we can start assembling parts together. Now, as far as like commonplace acceptance, it's not super-high yet. But I do know some companies that have already bought some equipment. Actually, desktop metal equipment. And they're already using it for production purposes.

Now, again, that's not data that they're going to want to share with everybody. But it is examples of "It's already being used." Now to what degree? You'd be surprised at what some of this equipment is being utilized for. And what material they're actually utilizing it to create.

And I think what's about to happen is in the world of economics that we're living in, where the supply chain is becoming more and more disruptive, we are seeing inflation. We're going to see increased transportation costs (and we're already seeing that). You're going to see that creative move toward more onsite production, using things like desktop metal and bound metal to produce more things

that they need right then, and they will start to qualify 'em then.

So, I expect over the next six to eight months, we're going to see real interest in additive metal because of supply chain problems. I mean, let's just face it: right now, steel just continues to climb. And it's even harder and harder to get. And so, this is really putting companies in a pinch. And the first thing that's going to be is: "Can we find another way to produce this stuff?" And here sits additive, and bound-metal additive, ready to meet that challenge. So, experimentation is driving it and it's becoming more and more of "a thing."

Mike: That's an interesting point. I always think about emerging technologies in our project. And what drives them. And it hadn't really occurred to me that the drive towards metal (in this particular case, additive metal) could be driven by supply chain issues, as opposed to just the technology itself. So, it's a fascinating point, Eric.

Eric: Innovation comes from need. It's what spurs it on. And so, when I can't get something, but I have something that could possibly work, I'm going to figure out a way to use it.

We saw that same scenario in the late 1800s. We had Pennsylvania suddenly bursting forth with oil. And everyone's concern was, "How long is this boom, going to last? How long we're going to have this supply of oil?" And then, all of a sudden, we see these new sites pop up. (I think Ohio. Or maybe it was Lima, I believe?) They started seeing oil wells shot up. But it was full of sulfur. It wasn't as quality of oil. And so, investors and entrepreneurs realized, "Well, we've got this inferior product. But I bet, since it's low cost, we could buy a lot of it, and find a way to make it better."

Mike: Yeah.

Eric: The exact same mentality here. You're going to see folks who find a way to use what's available, that's lower cost (but still available), and make it work.

Mike: I got two questions left for you, Eric. And let me tell you the first one. I was very impressed by your recent video that talked to students, right? You said, "Have you thought about a career in this area? Did you know there are nine different professions really, that they could enter—

going into additive?" And I was surprised about the breadth of them. Tell us a couple of the ones that we might not recognize?

Eric: Sure. That was a really interesting project to put together, by the way. You know, we started off with the concept of, "What would it be like for a career change?" And it was the research into that that brought us to some of the things that we found.

One of the things that I was really surprised by is the "artisan side." The ability to turn around, and take a product, and create a new form of art. I mean, let's face it, we have platforms that were built for this economy. You have Etsy, for example, that loves to sell quality, custom, artistic-based settings. And it's perfect for additive. We are seeing the construction industry moving... I mean, it's already there! You already have entities already doing construction printing. And that's a straight-up additive application, if ever we've seen it! And we haven't even begun to touch how design can affect that.

I think also, it'll be surprising for folks to learn how much dental work is 3D printed. And how much additive plays into that part.

Custom products in small business development. So, we're seeing folks go directly from low-cost printing, straight to Amazon, straight to market. There's no middle man in between. They go concept, prototype, production, out the door, and shipping. And as they need to scale, they just add on more printers.

The "side hustle" is the other part of it, too. Is that this allows folks to build into a side hustle. Build into a product. Because the fact is, in a connected world that we live in, if you have an idea of a product that you would find useful, there are millions of people out there in the world that would also find it useful. The barrier, of course, has been you taking the leap—and the risk—to introduce your product. And that barrier is no longer there! You can literally get started with a few $100, if you wanted to!

Mike: Yeah.

Eric: So, that's part of the entrepreneurial mindset and potential career change. Because that's who we work with.

We work with folks who had this little idea. They tried it out. Turns out, it starts taking off on Amazon or some other platform. And they've changed their career to focus on this. So, it allows a person to possibly even pursue their passion. And become a new career that they really, really enjoy.

Mike: Great points. I'll make sure we link to that video in the Show Notes. Here's the final one, Eric. A lot of our listeners are faculty members around the country, community colleges mostly, some at universities. They're thinking, "How do I bring in additive? How do I get started? Maybe I'm teaching manufacturing technology. Or engineering technology. Mechatronics. How do I best bring in additive?" Now, not all of these faculty members have direct experience with additive, you know. And that makes it harder to bring it into your curriculum, if you don't have direct experience yourself. Is there advice that you could give? Let's say a faculty member who wants to bring it in. What should he or she do? How can they best get started?

Eric: That's an excellent question. And so, to answer it, I'm going to think back in terms of "how we got started" and "the things that we've learned."

One of the warnings that I always give folks is just because you have a 3D printer in your classroom, doesn't mean that you're teaching 3D printing. Because what we had seen is that a lot of folks would get a 3D printer, and they would just do what they're normally doing, such as CAD and they would have it print off something they designed in CAD. Or they would have it in CNC, they would have it make something they're already making. To say it that way, not too negatively... I mean, that will get you at least started.

But what you really want to do is "not go in big." Don't buy a bunch of equipment. The best thing you could possibly do (as an instructor) is that you go get one reliable printer, especially if you don't have a lot of background. Get one reliable printer. (And you're welcome to check out the material that we have on our YouTube channels and everything else about it.) And you start printing something that YOU find interesting. You go through a few steps in slicing. You get just the very basics to make something YOU find interesting, passionate about perhaps, within your

educational field. And then you start taking it to the classroom and saying, "Well, look what I made with this! And how it relates to our particular component within lecture." And THAT's what gets the ball rolling.

If you go at it from "I'm going to teach 3D printing by getting a printer, and finding some curriculum..." and just throwing at it that way—it doesn't have the effect. People need to see the passion. You need to FEEL the passion of that.

So, step one is buying a printer that is low cost but is reliable. (Folks can always reach out to us. Or check some things out that we have. That will give our opinions on what we have found to be effective for this matter.) But then start focusing on products, or items, or graphics, or things that relate to what you're passionate about within the educational field. And that passion will flow out from you into your students in that work. And then from there, it will start to grow and build itself. THEN students will get involved. THEN more things to created. THEN more printers get bought for your lab or your applications. (And also, we have tons of resources to turn it into a educational curriculum.) But you have to get the ball rolling with passion first, and equipment that you can tinker with. And improve upon. But will still work. That's been what has worked out so well for us.

At this point in time, we've gone from one site to a statewide program. And we are training fifteen to twenty K through 12 teachers every semester, in addition to our students. So, they're going out and training their students all the way from middle school up—through the advanced Kentucky program. And we're doing that every semester.

And so, it's gone with this mentality of: "Let's find what interests you. Let's get you a single printer that works. And get you some basics. Let you play with it. And then, let it grow from there."

Mike: Sure. Eric, I just so appreciate your comments today. Because your passion for this comes roaring through in your discussion. And your advice is: "Get passionate about this!" And so, you're modeling that for us.

I think the way you've approached this—through that Certificate you develop now, the statewide curriculum,

statewide program, the thinking about, "What are the right processes to talk about?" the design side—it just makes a lot of sense.

Boy, was I struck today, Eric, when you said, "There's no one customer out there. You've got small folks. You got big ones. You got aerospace. You've got everything. You've got side-hustle folks." So, adapting to that situation. That's a challenge for us. But boy, we can look to you and see a program that's done it. So that's good.

Eric: I appreciate that. It's been a pleasure. We've gotten to work as a team with some great folks. And it also boils down to: once you get that ball rolling, like-minded people will gravitate to what you're doing. And that's a key factor, because you can't do it alone. It takes a partnership of many folks, with many different connections, from major fields, but it does take the first person to get in there, get the ball rolling, and create some passion.

Mike: That's a good point, Eric. Thank you, again. I'll make sure we put these links we've discussed in the Show Notes. And I bet you'd be welcome to have people follow up with you if they needed to.

Eric: Of course. We have multiple social media platforms that we put a lot of this material out on. Our YouTube channel, of course. We're happy to share the knowledge. And we're happy to partner up with folks that want to go down this pathway with us. Because we truly see additive as a "game changer."

Mike: Alright, thank you again. Pleasure talking to you.

Eric: Pleasure

Mike: Listeners, today you heard Eric talk about the drivers for 3D printing technology— additive manufacturing technology. And it was interesting because the drivers include entrepreneurship and supply-chain issues, which increase the availability of 3D printing to solve our current problems.

Today, I'd like to point you towards Eric's Certificate Program at Somerset Community College. You can see the link in the Show Notes. It'll give you an idea of what you can do to bring additive manufacturing into your curriculum.

Today I want to also acknowledge John Chamberlain, our audio engineer who does a great job of producing these

podcasts. Thank you, John. And acknowledgement to Ann Claire Anderson, Principal Investigator of our project. And thank you, our listeners for ***Preparing Technicians for the Future of Work.***

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