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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 Tom Tubon at BioMADE. Now, Tom is the Chief Workforce Development Officer there. So, welcome, Tom! Would you tell us a bit about BioMADE? And what does the Chief Workforce Development Officer actually do at BioMADE?

**Tom:** Sure! Thanks, Mike. BioMADE is the 16th Manufacturing Innovation Institute. It is ??? supported through the Department of Defense. BioMADE stands for Bioindustrial Manufacturing And Design Ecosystem for the Manufacturing Innovation Institutes. Essentially what we are is we're a public-private not-for-profit that's focused on building an end-to-end ecosystem for technology, and for workforce, and space of ??? engineering biology, industrial manufacturing,

industrial biomanufacturing, and focus. So, that's pretty much the overall charge. We have different areas of BioMADE that we are focusing in on to achieve this goal. And those are our Technology Teams and our Education and Workforce Development Teams.

**Mike:** I read this quote recently, Tom. It says that "Biology is having its own Industrial Revolution." That's a pretty interesting quote, isn't it? But what does a technician do today in the world of advanced biomanufacturing? What sort of things do they do? Not all of us understand that?

**Tom:** Well, I would have to say that the short answer is, "Just about everything that you can imagine." So, we're beyond the zone of what we would consider traditional biotechnology when we think about a biomanufacturing technician. So, in a generic sense, we can really divide things up into different areas for industrial biomanufacturing into upstream and downstream processing. And we can get a little bit further into the definitions for those. But, in a nutshell, what really these manufacturing technicians do are the myriad of activities: operational, critical components of producing these products that are used for commercialization or for scale-up. These can be processes that are involved in fermentation, gene cloning, all the way through downstream manufacturing, and laboratory work that involves purification of these products for commercialization.

**Mike:** If I'm in one of these education programs that's preparing me, how much biology do I have to know? How much manufacturing do I have to know? Or is it all mixed together?

**Tom:** That's a really interesting question, because what we're looking at now is more of a transdisciplinary approach to addressing what's actually required to be part of this career pathway. So, biology is really important. Everything begins with the cell, or cell-based products.

But as we move into the manufacturing process, one starts to integrate principles of engineering. It's really a transdisciplinary area to get into.

So, you do need to know about biology, and biology of the cells. But it's also really, really important to know those principles and concepts that we can pull from other disciplines as well. So, it's a real mixed background in academia that we look for folks that come into this area.

**Mike:** Okay, it's interesting, Tom. Our project, *Preparing Technicians for the Future of Work*, has really begun to focus very sharply on what we refer to: those cross-disciplinary—you said "transdisciplinary"—skills (I think it means the same thing.) Where do they cross? What do technicians have to know?

Let me ask you this question. From your knowledge of the biomanufacturing workforce...you would look at people that come into that workforce. Are their skill gaps that they're saying, "Oh, boy! I wish these people would know more about 'this,' or more about 'that.'" How do you know what those gaps are? What are they? How do you know?

**Tom:** I like that you asked that question, because we're really working very hard through our institute to provide the most directed answer to address that. Because I think that understanding what the issues are, and identifying what those skills, knowledge, abilities that are required for our industries—WE need to know that in order to direct the workforce! That's kind of a given.

In the area of bioindustrial manufacturing, with this area being so new, at least in terms of the idea of transition to scale up and commercialization, an entirely different skill set is going to emerge and is emerging now. And we are grappling with what that skill set is. But at the same time, working with academic partners to figure out how we can include those in current and existing curriculum for CTE programs. So, there's an interesting challenge that we're facing, which is to essentially "build this plane while it's flying."

**Mike:** Sure.

**Tom:** And that's something that people say all the time. But it's a different story when you're in the throes of it all. Yeah! We're identifying what those specific skill sets are. But we're also trying to make sure that we do this in a way that impacts the industry as quickly and as efficiently as possible.

**Mike:** Tom, you've been involved in industry—CTE programs, the education side—for a long time. Do you see challenges? I'm trying to think of the right word, Tom. Is it "challenges" or "reluctance?" I mean, you've got someone that's running a biomanufacturing program. Are they okay with being told by industry or by (in this case) the Manufacturing

Institute (BioMADE) what they should be doing? Are they okay with that? Or is there a resistance?

**Tom:** [laughing] Well, if you could see my camera on, you would see me laughing! Because the real point of a lot of these career technical education programs, these workforce development programs, are to develop that workforce. We can only do that successfully with guidance and input from the industry. And so, to not take industry's suggestions and industry's information and to mobilize with that would be probably the most dire mistake that one can make.

So, there are some challenges that institutions have for adopting industry suggestions and industry input, and it more has to do with "What can we reasonably do to modify curriculum? And how fast can that happen? And what is the institutional buy in to do that?" These are all questions that can be answered by demonstrating that there's a really strong industry push.

So, when industry comes in, and they validate programs, they hire the graduates, they give suggestions for what they would like to see included in the curriculum, it really is about integrating those points as best as possible. Because at the end of the day, we're looking to increase capacity for workers in bioindustrial manufacturing. And the best way to do that is by honoring what is needed and identified by the stakeholders. In this case, we're talking about our industry members.

**Mike:** Sure, that makes sense, Tom. And I see the challenge there. But have you ever run into a situation where, let's suppose you have a faculty member, and they're saying, "Here's the things you should be putting into your program." And they're saying, "Wait a second! I've got a limit here. What should I take out if you want me to put these things in?" Do you have those sort of discussions?

**Tom:** All the time! And I think that this is a really careful balance to strike between the academic push for curriculum and the industry pull. And so, in that scenario of a tug-of-war, there are folks on one side or the other that are tugging at that rope. And I think that we've got to change that kind of a scenario to "What can't be included?" Or "What should be not included?" Or... It's an issue that is more part of the individual approach to what they think is important.

And to be honest, Mike, I think that part of the issue is, as a former professor in a biotechnology program, we have to recognize that we're not always the driving force. That we would stand to benefit greatly from yielding and just listening. And maybe I'm just speaking for myself, but that ability to listen and to really integrate important suggestions is the game changer for a lot of programs.

**Mike:** I like that, Tom! It strikes me: maybe the messaging that comes from BioMADE, which represents a large segment of the industry, can help programs say, "Oh, yeah. This isn't just one industry speaking, but rather it's this organization that represents these industries." Maybe that makes it easier to accept the suggestions to move forward.

Tom, let's turn back for a moment to—you refer to them as—"transdisciplinary skills." (We call them "cross-disciplinary skills." Same thing, I guess.) What should a biomanufacturing technician know, and be able to do, when it comes to something like cybersecurity? Should they have an awareness? Should they have more than awareness? Is there cybersecurity knowledge and skills in these programs now?

**Tom:** Cybersecurity is on everyone's mind nowadays. And I don't think that it is separable from any industry or any area that one goes into in the biotech world. For us, when we think about a manufacturing technician, skilled technical worker, entry level, all the way up to maybe a management-supervisory level position. Those issues with bio and cybersecurity are critical. Because a lot of the things that we're talking about—the products of bioindustrial manufacturing—impact, let's say, for example, supply chain. They impact elements that influence directly the national security and the economic return. These elements are not separable from whether we're dealing with the access to the product, the manufacturing of the product, the process. Cybersecurity is kind of one of those things that we need to be aware of. Everyone in the field needs to be aware of this. So, I don't see it as a separable component here.

**Mike:** So, it ought to be part of those programs in some way.

**Tom:** Absolutely. Cybersecurity should. Elements of sustainability. For how the work that one does really does impact the ability to contribute to a sustainable supply chain. There are a number of elements that are above and beyond the core biotech skills—a hands on operational—on

the day-to-day job that really make this career pathway very distinct from just a "job." This is a "career" for folks that really launch into manufacturing. There's a lot of growth to be had. And just being a part of that career pathway really does involve investment and understanding a little bit above and beyond the operational skills required to be an efficient, really, really well-rounded technician.

**Mike:** I'll keep you on the hot seat, Tom. What about Artificial Intelligence? And Machine Learning? How much should a biomanufacturing technician know today, or maybe in the near future?

**Tom:** I think that they're gonna have to really embrace a lot of these different concepts that are in the area of artificial intelligence, computer-based learning. And then also, areas like robotics and automated manufacturing.

We're entering—and I liked the way that you referred to this in the very beginning—a new industrial revolution. And I think that bioindustrial manufacturing is one of the catalysts for the fabled "fourth bioindustrial revolution" here. Which is really the integration of all of these things into a context that's really going to be an explosion of both the technologies and the products that we can develop. So, "inseparable," in one word. But also "invaluable." To be aware of these different areas. Because the fields are advancing so quickly. The technology is happening right before our eyes. That integration of all of these different things through automated manufacturing, and the way that we conceive the manufacturing laboratory that has to really integrate these principles.

**Mike:** In that same vein, Tom, if you give us your perspective of what it's like, inside those industries today. For example, things are changing fast, as you mentioned: much more automation, much more technology coming in. How does a technician currently working keep up? How do they "upskill" in the biomanufacturing industry? Do they take a noncredit course at a community college? Do they get vendor training? What do they do?

**Tom:** For our industry partners, I know that there are a lot of our companies that we work with that have internal opportunities for professional development. For upskilling and uptraining, that becomes a really great area. Because you're talking about developing resources that are based on

(in many cases) emerging technologies which really lend themselves to new and innovative techniques.

And so, where do those come from? And do we provide that? BioMADE is definitely poised to be one of the major sources for that information. And we're hoping to work with our tech and community colleges to really integrate that into the core of their approaches to dealing with bioindustrial manufacturing. This is one of those areas that really, really does demand a dynamic curriculum, and the faculty and institutions that are willing to embrace that, in order to create meaningful opportunities for professional development and upskilling.

**Mike:** Sure. You mentioned that you want to work with colleges. How does one interact with BioMADE? How do people connect with you and your institute to make this happen?

**Tom:** So, we have a really interesting membership structure. We have 10 different tiers of Membership. And so BioMADE is a member driven organization. We are not for profit. But we are also in the business of connecting these groups together—between our industries, and our academia, our government entities.

Because we are a membership driven structure, it's difficult sometimes for very resource-sparse institutions to engage because of the Membership Fees. And so, we recognized that when we developed BioMADE's membership structure, and we actually developed a very specific training tier to engage community and technical colleges, not-for-profits, our K12 partners— anyone interested in the Education Development area. We dropped the Annual Membership Fee down to \$100 per year. So, it's a very, very reasonable Membership Fee with a huge return on investment to access resources, the ability to apply for grants and funding opportunities, and engage the industries directly with some of the most impressive emerging technologies and industrial manufacturing.

So, if you're interested in being part of this organization, and finding out more, I just say the first stop should be: go to the website, which is "BioMADE.org." That's a good launch point. And of course, feel free to contact me at any point in time. And I can give you my email address here, tctubon@biomade.org.

**Mike:** I'll make sure I put links to those in the show notes, Tom, because people really appreciate that ability to directly contact you. Good. "biomade.org" And then we'll make sure. I promise not to post your email on eBay for sale.

**Tom:** [laughing] That'll be sitting there for a long time! Thanks, Mike.

**Mike:** Good, Tom. You know, as we wrap up today, get out your crystal ball. What would you see? What's emerging in the next three years? And a corollary question: What advice might you have to educators to help prepare students for those emerging technologies? So, a two-part question: What's emerging? How do you suggest educators best prepare their students?

**Tom:** So, one of the things that I see... We're in the middle of a major, major push for industrial biotechnology, and we're seeing this now with places that are common for everyone. Burger King's producing these Impossible Whoppers. We're seeing cultured meats. We're seeing a lot of these things that are hitting the open market now. And so, in the next three years, what we're going to see is rapid change from concept to commercialization for a lot of these products in the bioindustrial manufacturing space. And so, catalyst for the revolution, if you will, it's going to happen—and very, very quickly—if we can align the players in the right context.

For academicians and for industry partners, that means really identifying the commonalities and breaking down those silos that traditionally separate us, so that we can find that common ground to build something phenomenal on. And I think that that's going to happen!

And I think that BioMADE will help to serve as a catalyst for that. But we can't do that alone, we need the players to come to the game. And, if you will, we'll referee the game, or we will keep the score, and make sure that everyone is on the field. But it takes an "all hands on deck" approach to do this!

**Mike:** That makes a huge amount of sense, Tom. And I love that term, but I'm gonna quote you: "catalyst for the revolution." I like that.

**Mike:** Yeah.



**Mike:** But it's good. It's good. Well, today you just gave us such good perspective about this industry that really is undergoing a revolution now. And really does incorporate skills across disciplines—how important that is!

And then, you talked about those needs for the skilled workforce—particularly important to help these companies move forward. I think BioMADE is an interesting organization, right? It positions itself at the center of this thing! Helping translate the information from one side to the other, and back and forth.

**Tom:** I want to say one thing—and this is worth keeping in mind—as we think about what's out there for bio. A lot of folks think about bio, and they think about how incredibly amazing applications are in medicine and in pharma.

And, to that point, no one really considers bioindustrial manufacturing. It's like, "Okay, this is petrochemicals." Or "This is something that may not necessarily impact human health, or medical therapeutics, or anything." But it DOES have a tremendous impact!

And this is the point that I want to get across: that, if you look at the global bioeconomy, and you think about the things that support the supply chain, about 60% of the product, which goes into the supply chain for the global bioeconomy can be created using biology. So, those are elements that are not pharma, not therapeutics, but the things that we use on a daily basis that make our lives better. Now, if we can take 60% of the world's items in supply chain and produce them by biology, we've created a sustainable resource! And THAT's where the revolution starts! Or maybe it's what propagates all of these great things to continue that wave of change.

**Mike:** You're painting a fascinating picture there, Tom.

**Tom:** [laughing] My job is to pitch this, like the way that I see it personally. I mean, there's a reason why I'm here at BioMADE and I'm putting all of my interest in making sure that we can get as much done as we can here.

**Mike:** That's great, Tom. That's a great way to wrap up for today. I'll put links in the Show Notes, and give some folks some action items to follow up on this conversation. Tom, it's just a pleasure talking to you again today.

**Tom:** Always, Mike. As it's great to talk with you as well.

**Mike:** Goodbye then.

**Tom:** Bye, Mike!

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**Mike:** In today's interview, you heard about the emerging bioindustrial manufacturing sector, and how that's being championed by the BioMADE National Manufacturing Institute. According to Tom, they're acting as the catalysts for change in this area. Pretty interesting stuff!

Now, there's some action items for you today. Number one: BioMADE has produced a short video talking about the workforce opportunities in this sector. Check that out. There'll be a link in the Show Notes.

And number two: you heard discussion of how BioMADE is interacting with its education partners. BioMADE does that, but so do most of the other Manufacturing Institutes. So, your action item is to explore potential connection, or potential alignment, with the USA Manufacturing Institutes. Imagine your being able to say, "Our program is aligned with the recommendations of 'this' or 'that' institute." So, take a look at that. It'd be a good opportunity to follow up on.

I'd like to acknowledge that our podcast is produced by John Chamberlain at CORD. Thank you, John, for all of your excellent work. Our project is led by Principal Investigator Ann Claire Anderson at CORD. Thank you, Ann Claire.

And listeners, as you access this podcast on the website, right next to the Show Notes, you'll see a Feedback Survey link. Take a moment. Answer those brief questions. That'll help us improve these podcasts.

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