



Podcast Episode #32 – Why manufacturing in USA vs China is becoming interesting, with Scott N. Miller of Dragon Innovation, USA

RAW TRANSCRIPT OF INTERVIEW

Balint: I'm talking to Scott Miller of Dragon Innovation and I'm very glad about this as Dragon Innovation has a long track record of working with hardware startup companies. Welcome, Scott.

Scott: I'm thrilled to be here and looking forward to our conversation.

Balint: I got introduced to you by Finbarr Watterson of Fictiv, a guest from episode 27. I'm quite happy and thankful for that. I'm happy that this could happen, this interview, and I'd like to start with a quote: "The concept of global warming was created by and for the Chinese to make the U.S. manufacturing noncompetitive," said Trump. Who else? I think it's a pretty funny one.

Scott: Yes, absolutely.

Balint: He has a couple of funny sayings. In this episode we're talking about manufacturing. So this is why this quote I thought is relevant but we will not dive too much into politics. Now that I brought up this quote, what do you think about the status of U.S. manufacturing and how does it compare with the manufacturing in China regarding the wages of people working in the factories, the quality? Because there have been changes going on.

Scott: Yes. Yeah, things are rapidly evolving and when we think about it and trying to figure out what geographic base would be the best to build a product we look at a few different things. And if we just constrain this to the U.S. as one option and China as another one, to keep it simple, one of the biggest factors is the quantity of units you want to build and for my remarks here I'll just keep it to consumer electronics which is what I know best. If you are building automotive or industrial or fast moving consumer goods or things like that, the decisions may be different. But I'll just focus on what I know.

So, typically we think if you're building under five thousand units, there's a lot of reasons to build domestically in the U.S. in that it's much easier to talk to people on the same time zone that are hopefully just a short drive from you, with a similar culture and a similar language. Whereas as you start to think about building more than five



thousand units and roughly in the course of a year, then China can start to have some advantages in that the labor rate is certainly cheaper. What we see in China is labor rates about 3.50 an hour. It tends to grow 20 percent year-on-year whereas in US it depends on the vertical but anywhere from \$18 to \$50 plus an hour. So that's certainly an important differentiator.

But we also see in the U.S. things are more horizontal and by that I mean that if you wanted to build a consumer electronic part, you may need an injection molder that's going to do the plastic and then a PCB house that's going to stuff your boards and then another factory to do the final assembly and test to kind of managing three different factories in this scenario. Whereas in China, in our experience it tends to be more vertically structured so that everything's under the same roof. And if you can pick the right factory, that can certainly give you advantages, even as you're building the higher volumes tend to dominate the equation. So that's just sort of one way that we look at it.

Balint: So now you quickly briefly covered the wages and also this vertical integration in factories in China versus the U.S. where the same things, the steps happen in different factories. And what about the quality?

Scott: Absolutely. Yes. The quality coming out of China maybe 20 or 30 years ago was terrible. People were just looking for the cheapest product they could find and in our world when we think about manufacturing we always think of the manufacturing triangle. So anything like manufacturing that's insanely complex. You try to break down into simpler pieces that are more bite-sized and that you can control and manage them. So for us, the manufacturing triangle is cost, quality and schedule and it's a matter of balancing all three of them.

But the quality that we've been seeing coming out of China for the last even 10 to 15 years has been phenomenal. You can get highly complex electromechanical products that can be food safe, that it can have multiple radios, really beautiful aesthetics and finish. So we've seen China evolve quite a bit that can get a great quality product. Certainly, they can be very cost competitive, especially if there's any sort of labor included. And on the schedule, that's where it can be a little bit more challenging in that if you are building it in the U.S. and selling in the U.S., it doesn't need to go very far. But typically if you build it in China, it takes about five weeks to get it from southern China over to the U.S. and that has all sorts of different implications.

Balint: Yeah, because of the distance mainly.

Scott: Yes. And distance and then the ripple on effects like cash flow that you need to be able to carry the cost of all that inventory. Whereas with just one or two days, you can sell it much quicker and get your money out again.



Balint: I started with this topic manufacturing in China versus the U.S. because you're present at both bases. Even the name Dragon Innovation indicates that you have some connection with China. So can you tell us about your company, about also the connection and describing what you're doing?

Scott: Sure, yeah. So, for me, I'm a mechanical engineer by training and always loved robots and had the chance to build a whole bunch of them from robotic tuna fish at MIT to full size walking robotic dinosaurs at Walt Disney and those we all built domestically.

But really where I first got introduced to manufacturing in China was when I was working at iRobot and we had a joint venture with Hasbro basically where we were going to bring high technology toys like a pipeline of prototypes to them and then leverage their manufacturing line. And in the process of this relationship we ended up building an artificially intelligent robot baby doll and then some pretty cool smaller walking dinosaurs. And that's really where I had the opportunity in the early 2000s to go over to China and learn or begin my journey of learning how manufacturing works.

And what we've done at Dragon is really working to make manufacturing accessible to a greater number of hardware companies that are doing new hardware introduction. So we try to light the path from prototype to production through the software we've built and just through the expertise and solutions that we have on the team. But it's basically been over these last 15 or 20 years that we've gone through it first... As a hardware company, at iRobot doing the Hasbro toys and then ultimately the first four million Roombas and then working with Dragon and helping companies like MakerBot, Sphero, Formlabs and so on, Pebble is another one, take their prototype and then figure out how to scale safely.

And since we've typically focus on consumer electronics in the higher volumes, China's been a natural fit. But now that Kickstarter and crowdfunding has been able to enable many more amazing products we are seeing greater need and an even better fit for manufacturing in the US. So we're certainly expanding working with the city of Fremont in California and then in New York City, Massachusetts, to be able to help set up those pipelines to help domestic hardware companies be able to build on-shore.

Balint: I want to come back to this topic, the Kickstarter topic, because of some recent news coming out, between Kickstarter and you, some collaboration. But before that, well, you mentioned it briefly that you started in 2000 so you definitely have a track record of working in manufacturing and also because of the long list of startup companies. That again means you have a lot of experience working with startups. So that's very, very nice. And how is the business model that you work with?



Scott: Oh, sure. Yes. So, we have a couple of different models. One of our big focuses these days is creating software to basically provide the tools that enable hardware companies to safely navigate from prototype to production. And we've got a couple of products out there. One of the ones we're recently in private beta with is something called Product Planner, which takes a bill of materials centric approach to helping companies understand can sites, things like cash flow. So how much money did they actually need to deliver their product or break-even reports? So how many units do they have to manufacture before they go from the red to the black? Basically, paying off their CAPEX. Or COGS analysis. COGS is the cost of goods sold so understanding how much does it actually cost to build the product.

So in that case it basically just works or will work on a SaaS basis. We're trying to build tools that live between Excel or spreadsheets where everybody starts but give them a much better solution rather than having to install enterprise grade software where you have to sit in training for a week and it cost tremendous amount of money and we're trying to address that gap with our software. So that's one solution.

And then, we also for pretty much ever since we started have been providing solutions to help companies do design reviews and then select factories much better than they could ever find on Alibaba or global sources, and then create the quality plans, costing and sourcing and even project management where we can have dragons embedded in their factory in China to provide their eyes and ears so they don't need to be flying back and forth. So we sort of think of ourselves like a fishing guide where we can help our customers figure out where's a good spot to fish. And now that we've been writing a lot of software we can by way of this analogy even give them a fishing rod so that they can go and cast and pull in their own fish.

Balint: I had the luck of being introduced, of being shown a demo of the Product Planner and I liked it. Again, thank you for this opportunity because I could see the features that you have and you have to be an Excel virtuoso to be able to come up with such functionalities that you have. So one feature that I liked is that you can have different MOQ, minimum order quantity, that you can work with and the break-even calculation takes this into account. So if you assume a certain retail price and a certain cost that you work with, cost structure, it calculates during the calculation so how many units you have to sell to get a breakeven point. It takes this into account, the MOQ. So I think it's a very, very interesting and you can also bring in product sheets into this software. So I think it's going to be a great help and I'm pretty sure that hardware startups will be happy to use it or even now they're happy to the beta version.

Scott: Oh, well, thank you. We're super excited about it. And what we have seen over the course of working with hundreds of different hardware companies and some



small, some quite large, is that every company has a different Bill of Materials. There's no one set former standard. And as a result, it creates a lot of inefficiency. And this is particularly hard when the consequences from making decisions incorrectly are very steep. So what we're trying to do here is set the standard and create a BOM that captures the sufficient information to actually build the product. But does it in a format that's a lot more efficient as you were saying than a spreadsheet. Because what we see is if you actually do put it in all the data that you need to try to create this BOM as a document, you get in the column like x x and z z and w w, like it gets really, really wide and super inefficient. So with this now that we've got the data we can present it in a format that's conducive for whatever you're trying to do whether it's looking at a parade of your high cost components and the high cost report to see where you should focus to bring that down or you'd mentioned the break-even report.

We also do things that are not really intuitive in Excel. So when you're building in volume, as you noted, you start dealing with MOQ, minimum order quantities. So for example, if you are going to buy a reel of capacitors, they might sell that in a quantity of 5000 units per reel but if you only needed 4000, you still have to keep track of that extra 1000 that you haven't used because they have a very real cost associated with it. And with Product Planner does that all for you automatically. So you can really focus on building your product and have really good visibility to help you see around corners so that you can make those critical decisions correctly at the right time.

Balint: When is the final version coming out? And how does this software product differ from the Dragon Standard BOM free tool Google sheets add-on?

Scott: Yes, so we'll be publicly launching Product Planner this summer and are super excited for that. For the Dragon Standard BOM, as you mentioned, it lives in a Google sheets some add-on store and basically that's a free template that we built just to help companies get a head start so that they could have a canonical format for what a BOM should look like. And there are some simple analytics we built in like checking for duplicate parts and things like that but that will always be free and we're excited that almost 4500 companies have installed it and are using it to build their products.

Balint: 4500? That's a pretty good number.

Scott: Yes. Yeah, we're thrilled it continues to take off. And I think just the idea of being able to help companies set a standard for what a BOM is makes it efficient for everybody in the ecosystem whether it's the factory that they're trying to get a quote on, quote for the product as part of the RFQ or just collaborating amongst themselves. But there's definitely a much better way to do it than a spreadsheet.



Balint: Scott, now going back to the topic that we briefly mentioned, the word Kickstarter, regarding crowdfunding, I was wondering what kind of tips you have for startups that you think they should think about when going this route, crowdfunding route, and what the latest status is regarding Dragon Innovation working with Kickstarter?

Scott: Yes, well, yes. So we just announced that Dragon was teaming up with Kickstarter and Avnet to launch something we call Hardware studio which is designed to help basically creators on Kickstarter be able to plan for their campaigns that involve building a physical product ahead of time so that they have a much clearer picture of what's involved and an easier path to delivering because we all know hardware is hard. We're just trying to make it a little bit easier. We're thrilled to be teaming up with them. Avnet is one of the largest distributors of electrical components and just has tremendous amounts of domain knowledge in terms of being able to look through our bill of materials and know the health of each component whether it's going to be end of life or not, if it's compliant with ROHAS and so on and also understand the pricing. So I think by combining all three of us we're able to offer a really unique package to creators as they go in and build the future.

In terms of the specifics of what you need before you launch a Kickstarter campaign, what we recommend is one really understanding your Cost of Goods Sold or your COGS, said simply this is basically how much it will cost you to buy the product from the factory. We've seen companies get into a lot of trouble if they don't understand the COGS or they guess at it in that they can be losing money with every unit they sell, namely if they're selling it for less than it costs them to make it. So certainly understanding your Cogs, and along that theme you also want to understand the capital equipment requirements that you need to build your product. So this would be the injection molding tools, any sort of test fixtures, stencils and things like that because they can add up pretty quickly and they're often not captured when you're trying to figure out what threshold you should use for funding. So that's on the cost side.

On the schedule side, just understanding the different steps from where you are now with the working prototype and what's required to get into production and how long they take. And then, the third part is what we call a design readiness. So are you to the stage where you've built a 3D printed part and you have one or two of them working? That be early in the design readiness versus something that's tool ready, it's full, drafted and rounded parts with that uniform, wall thickness that can go straight to the tooling design phase. So being able to understand that and that would impact your schedule, your quality and also potentially some non-recurring engineering or NRE to get ready for the design and manufacture assembly.



Balint: Yeah. I like that in your program, the Product Planner, you can take into account these factors, right? I remember the NRE.

Scott: Yes.

Balint: Yeah. There's a field for that.

Scott: Yeah, absolutely. We give our companies spots to keep track of the detailed NRE of any sort of compliance so FCC or CEE, ratings things of that nature for all the tooling and then we can factor that into... If you are to amortize that across the volume that you're building, what's the per unit adder in terms of a cost? And all of this information our creator could use to figure out what's an appropriate funding threshold so that they make sure they raise enough money because we've seen time and time again that the leading cause of hardware death is that the companies run out of money and that's one of the things we're trying to provide better tools with by way of Product Planner.

Balint: Yeah. Very exciting. Talking about still the manufacturing of course, what kind of a trend or major shifts do you see? For example, in China, in Chinese factories you hear it these days that automatization is taking place because the wages are climbing slowly during the years and they want to, of course, still make money. So they want to increase the margins. So robots are appearing on the factory floors there. And what kind of consequences do you expect that will happen for these?

And also the other topic, that we discussed with the Jacob Rothman who has a factory, the Platform88, maybe you heard about that factory in China and he mentioned that millennials, this he sees it as a trend, that millennials are looking more and more for individualized products rather than mass produced, and that again will have some repercussion.

Scott: Yes, yes. I think your observations on both points are very consistent with what we've seen. So over the last eight or so years we've seen an increasing amount of robotics on the line to help automate. And as you said, it's typically driven by 20 percent year-over-year increase in labor. Manufacturing is historically a pretty low margin business and it's always under downward pressure. So factories are always looking for ways to protect their margin. And what I think is unique about the way that the Chinese factories have approached it is that they're doing it from a bottom up. And by that I mean that if you imagine a panel like a PCB or printed circuit board with a bunch of through hole components, traditionally you just have a worker with a soldering iron. But what we started seeing about five years ago is the factory had built two or three degree of freedom robot. And I use the term loosely, but basically just a device with a couple of axis and motion that would literally that you'd clamp a solder-



ing iron onto, it would know where the holes are for the components and it would just go through the process of soldering them.

They're getting more and more advanced so now for example, for Tempo printing they take a like a puma arm and put the jelly heads on that potentially six or seven different jelly heads and as fast as... It goes up fast you can barely see it but that will be the device that's... Tempo are doing the deco for the different components.

In China they have just tremendous engineering resources and creativity and the ability to build stuff. So it's a natural fit that they would focus on increasing levels of automation. What we see in the U.S. there's a lot of really interesting firms. One of them is Rethink Robotics, which is right near us in Boston. They're doing what I would say is a top-down approach where they're building almost a humanoid level robot with just incredible capability that can adapt to any sort of environment and be able to in some ways augment the factory workers. So you're absolutely right that robotics are going to play a bigger and bigger role particularly in consumer electronics.

And then, for your second point just about millennials wanting more customized things. We absolutely see that. I think the days of winner-take-all for consumer electronic products are waning and we're going to see instead of one company building millions of units, there's going to be many companies that build tens of thousands or hundreds of thousands of units that are all slightly different depending on what the end users' or customers' preferences are. As I look at that, I think that's such an exciting opportunity for US manufacturing because we had talked about earlier in the podcast, U.S. right now is perfect for the lower volume stuff where you want to go faster and there's advantages to being able to sit next to... To have the creator sit next to the factory. So I think that's incredibly exciting.

Balint: That also means though that startups will have to operate very, very lean, maybe even a leaner than usual because the costs might be higher this way if you're manufacturing in the U.S. in lower quantities.

Scott: Yes. If there's any sort of significant labor component, then the cost of goods sold would be higher although I think if we think of the crossing the chasm curve, the earlier sales are going to the innovators in the early adopters who would potentially be willing to pay a little bit more. And then if the volume does increase, then it could switch over to the early majority, which hopefully would stay in the U.S. but otherwise could get some of the efficiency from China.

Balint: So this creates... Of course, it's a very good news for startups because it creates tremendous opportunities. This is why you're also trying to... Well, you're ac-



tually offering this Hardware studio with Kickstarter because that's where the startups are some of them, especially for consumer products.

Scott: Yes. Yeah, I mean there's just such an interesting stream of innovative products being brought to life on Kickstarter. It's a phenomenal enabler for the hardware evolution.

Balint: Scott, I usually ask these days in the interviews this point, and I think is an important point. Many times people forget to talk about it, it's the mistakes. Mistakes we make. Because it's good to listen to stories with a good ending always of course, but usually there's a bumpy road to that end goal. What kind of mistakes do you see that you have made that you could learn from?

Scott: Oh, sure, yeah. I'd like to leave every mistake in the book but we keep making new and different ones and they're really the things that stick with you. As I say, that which does not kill us makes us stronger. So you really learn so much from when things go wrong. So I'll share with you a story that happened when we were building the Roomba and I just picked the Roomba because it was my own project whereas typically we can't talk too much about what our customers are doing.

But yeah, so we had spent three years trying to build the first 15000 units of Roomba and Roomba is just an autonomous for cleaning vacuum cleaner that we built in early 2000 and it was just a really, really challenging product on a tight schedule with a really tight budget. And as I mentioned earlier, there's three things you have to control: cost, quality and schedule. We did an amazing job on cost. In fact, the first cost of goods sold for the initial Roomba was 50 bucks. And of that \$13 was the battery. So within \$37 we got the box, the plastic, the boards and five motors. So we felt really proud about that. And I think that was one of the things that allowed it to scale. So check, we did that right.

On the schedule, we understood that most of the sales was going to come around the holiday season so that it was important not to be late. So we pushed really hard to be able to ship at that time. So for this story I remember sitting in China, in November, so right before the holiday season. We built our fifteen thousand Roombas. We're super excited that we're going to change the world. The thing is that we really just never had any time to test them because we were so focused on cost and schedule. And I think maybe we'd run a few robots five or six hours and it seemed to be OK but I thought before we shipped these 15000, because once they're gone they're gone, we've got to make sure that, let's say they last 10 hours. So we ran a bunch of them and after about the seventh hour they all started failing. Basically, what happened is we had a o-ring that we used as a drive bell and the wheel module. And for one reason or another it was getting worn out. And that created a lot of black rubber dust, which ordinarily wouldn't have been a big deal. But within the same cavi-



ty we had an encoder, an optical encoder just to understand the odometry of the robots we knew how far and when. And like a magnet, all that dust got stuck in the optical parts and it just totally screwed it up. So we are faced with like we get two days tops to try to figure out how to rework 15000 robots and thank goodness we caught it, it would have been much worse if we didn't figure out there was a problem. But there's such a short amount of time that we knew we couldn't change the tools, we couldn't rework anything to any significant level.

So fortunately what we ended up... We came up with a solution that fixed it. We ended up taking a piece of clear film and die-cutting it so basically just like a cookie cutter stamping out pieces and that served as a plenum that we were able... It's thin enough it didn't impact the assembly on tolerances. We were able to put it inside the wheel module and I kept the dust on the dirty side and fortunately, the optics on the clean side. So it still made dust but it just was contained. And with that I don't think we got one return. We got a lot of returns but not for that, not for the dust problem. So it's one of those like just being forced to think on our feet like, "Alright, we got two days, tops three to work 15000 units How can we do this without really making any big changes?" And that's like one of 100 stories that we almost died on.

And in some ways, that's exactly what we're trying to solve at Dragon is being able to provide transparency and help hardware companies see around corners so that they can understand that maybe they should test for quality ahead of time as opposed to realize it as an afterthought.

Balint: To avoid such problems. Yeah.

Scott: Yes.

Balint: That's a good story. So let's move on I would say to the last round which is the ultrafast round. So this means I would ask you four questions and it would be great if I could get short answers.

Scott: Sure.

Balint: So the first question. If you could go back in time to the time when you were in your 20s, what notes would you give yourself?

Scott: Yes. So one would be definitely like enjoy being 20. The body is healthy, the mind is free, there's not a lot of encumbrances. It's just a great... Not that now isn't a great time to be alive, but every phase has a different sort of theme. So just to enjoy it and it's going to be an exciting journey. And it's most likely going to work out OK.

Balint: Yeah. Enjoy the moment.



Scott: Enjoy the moment. Absolutely.

Balint: Of the 20s. The second question. If you had to name a book or even two books, what would be the one or ones that had the biggest impact on your career?

Scott: Yes. So I've always been fascinated by leadership and one that I always found super helpful for me is called *The Team Secrets of the Navy SEALs* and it talks about leadership, especially under challenging times. And it's a thin little book but I found there's a lot of good lessons in there from one of the most amazing teams in the world.

Balint: I read another book but it's also kind of by a guy who was in the military on a high level, British guy, Bear Grylls, you heard it but probably, he's like an adventure show taking even Barack Obama to Alaska and he wrote that to his kids (*Bear Grylls – A Survival Guide for Life*) I forgot the title but it's very, very interesting lessons that I could learn from.

Scott: Oh, interesting.

Balint: I have to check out this book that you recommended.

Scott: Cool, yeah, it's a pretty simple read but there's good, concrete lessons to be learned in there.

Balint: Yeah. The third question. I'm amazed by habits. Do you have some habits, work related or non-work related?

Scott: Yes. So, one thing I often do is for whatever reason I end up waking up at 2:00 or 3:00 a.m. in the morning and for me I find that that's my most creative time. So I often get up for an hour or two and try to accomplish some work that's otherwise difficult to do during the normal hustle and bustle of the day. And sometimes I just stay up and work through until when I go to bed. But other times I can just go back to sleep. So I found that really helpful and sort of that observation that that's a great time to be creative and not pulled in different directions.

Balint: That's an interesting habit. It's not something I would probably like to take on if I have a choice but if you have no choice, definitely good and more effective than lying in bed and thinking about all the creative stuff but actually not writing it down.

Scott: Yes, absolutely.

Balint: The last question. Because you definitely work across cultures and countries, continents, what kind of critical cultural differences have you seen during your work that you could overcome?



Scott: Yes, so it's actually instead of a difference, it's actually in a way that we're more the same than... Or the more I work across cultures, the more I learn that we're all the same. So, in politically there may be challenges between different governments but I find most of the people are incredibly caring and would be very good, close friends. So I think what I've learned is to separate the politics and all that from the people.

For example, I was born in 1970, which is at the end of the Vietnam War or kind of in the middle of it. So I kind of grew up with this not a great understanding of Vietnam but I had the opportunity to spend a lot of time over there. And we have many, many really good North Vietnamese friends, which for me sort of lit the light bulb that in general people are wonderful and it's really interesting to learn more and more about them and look at them as friends as opposed to people to be concerned about.

Balint: Yeah, definitely. I agree that on a deep level we are all connected.

Scott: Yes. Very much.

Balint: Yeah. And cultural differences are just one layer, but just below that we're all the same.

Scott: Yes. I mean certainly the differences in culture are fascinating but I find we have a lot more in common than I would have thought.

Balint: Yeah. So, Scott, to close off, to wrap it up this interview, I had a really good time. Thanks very much for letting us, letting me also learn about manufacturing and what the current status is, what the current trends are in the U.S. and China and comparing the two places and also talking about your company. I appreciate it.

Scott: Oh, well thank you for having me. It was great to chat and yeah, I really enjoyed the conversation.

Balint: And actually one last question. What is the best way to reach you, for the listeners?

Scott: Oh, sure. Absolutely. Yeah, we'd love to connect and the best way is just through our website, which is dragoninnovation.com.

Balint: All right. I'll put it into the show. Thanks again.

Scott: Fantastic. Thank you.