



## ***Manufacture Anywhere with Craitor 3D Printing***



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**Interview conducted by:**  
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**CEOCFO: *Mr. Shnell, what is Craitor?***

**Mr. Shnell:** Craitor is a 3D printing company that is working to develop rugged portable intelligent 3D printers, in collaboration with the US Marine Corps through a Cooperative research and Development Agreement, a “boots on the ground” approach to developing 3D printing that is usable by our war fighters in the field.

**CEOCFO: *What came first? Was it the idea of creating these devices and then you realized you could do it with 3D printing, or were you looking at 3D printing and realized that the DoD is a good niche?***

**Mr. Shnell:** Originally, the Marine Corp was looking into the implementation of 3D printing to enable distributive operations, essentially to refocus their supply chain and focus on conflicts in the future. However, they were struggling. They knew that 3D printing could have an impact. They knew it could help them, but 3D printers were not built around their needs. In fact, they found themselves working around the limitations of 3D printing, as opposed to 3D printers working around their limitations.

We originally were a team of student researchers out of UC San Diego that were introduced to the additive manufacturing unit at Camp Pendleton. This unit was looking to implement 3D printing and we actually came on for a short time as strategic technical advisors. That is where we got to see, firsthand, just how the limitations of 3D printing as making it difficult for them to actually implement. Therefore, at that point, we decided to make a 3D printer that works around the limitations faced by our warfighters, as opposed to making our warfighters work around the limitations of 3D printing.

**CEOCFO: *What have you developed?***

**Mr. Shnell:** Since then, we have developed a rugged, portable, intelligent 3D printing system, that is able to go into the field and is being tested alongside our Marine Corp in tactical environments. We actually have a Cooperative Research and Development Agreement (CRADA) with the US Marine Corp and NIWC Pacific, and we have been working with them since November of 2020, though since January of 2021, we have been directly integrated with the Marine Corp aboard Camp Pendleton.

We have been working with the Marines every single day, developing, iterating, and refining our product to a point in which we have now have a printer that has been tested in tactical environments alongside our Marines, and is being taken to production over the next 9 months.

**CEO CFO: *What did you do so that these 3D printers will work where it is needed? What were some of the challenges? What have you figured out?***

**Mr. Shnell:** Many times, when I talk to people, they originally assume that what we have built is just a 3D printer in a box. It is substantially more advanced than that. Therefore, we have been doing research and development on key sub-systems that are typically considered to be the most fragile, the most precise, that require the most calibration in environments, that are typically the failure points of any other 3D printing system when deployed in a tactical environment. We focused on those first.

How do we make those systems as autonomous as possible so they do not need an experienced Marine who has got years of knowledge and working experience to use it? We built those out to be as rugged as possible, and as modular as possible, so they can be easily maintained, easily replaced, and easily upgraded over the lifespan of the entire system.

**CEO CFO: *What might someone in the field be looking to create? What types of items?***

**Mr. Shnell:** We have been printing Marine Corp gear for the last year. Some examples include parts to communication equipment, transportation, and even medical. Many people ask me about weapons systems, but I will tell you that we really do not 3D print anything related to any form of weapons systems, so far.

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**CEO CFO: *What is involved with the materials that are needed? What type of supply might you be working with out in the field? How do you sync that up with the capabilities of your machine?***

**Mr. Shnell:** We are focused on polymers (plastics) and composites. While metal capability is something we look towards in the future, the focus on our first unit here was to be as portable and as capable as possible, as far up the supply chain as possible. We want this thing thrown in the back of Humvees, taken into remote environments, and used anywhere a war fighter might find themselves. That means that we have to limit ourselves to plastics, because metals just require more energy, more systems, and more safety to be able to use reliably. They do not lend themselves to the very expeditionary type of environments. However, we have gotten around that by using advanced ultra-polymers and composites.

We are the only portable 3D printing system that is capable of printing Ultem® in the field. Ultem, otherwise known as PEI, is a material that has actually been tested quite extensively by the DOD. It has strength characteristics pretty close to that of aluminum. It is capable of dealing with many high temperatures, UV, chemicals, and is also autoclavable and sterilizable. It has been approved for medical use. It is also the only 3D printed material approved by the FAA to be used aboard airplanes. It is quite the ultra-material and lives up to its name. We have been using that extensively in the field, alongside composites like nylon carbon fiber, and nylon fiberglass and various other materials. We have had a lot of success with those polymer materials so far.

**CEO CFO: *3D printing has evolved over time. What was the beginning concept at Craitor, and what do you have today that might be better, faster, cheaper?***

**Mr. Shnell:** You are exactly right. I feel like 3D printing almost changes by the day, and there are many capabilities being developed, and we have taken advantage of that. Our ability, the technology that we use to print Ultem, and those high temperature materials in the field, requires us to use an independent heated chamber. That was actually patented up until last year, so we were not able to make use of that technology. However, since then we have been able to implement it and be able to implement it reliably for tactical deployment.

We actually originally started out trying to build a 3D printing system that also provided machining capabilities, like milling and various kinds of subtractive manufacturing capabilities, because we wanted to be able to provide metal. However, as

we saw with Ultem opening up through expanding technology capabilities, as the material science started to grow and mature within the 3D printing field, we saw that more and more, polymers could take that place, and they have.

The biggest improvement to 3D printing, I would say, over the last 5 years, is not any one machine, is not any one way of doing 3D printing, it has been the development of the materials that we can 3D print for optimization for 3D printing, strengthening, and providing new ways of printing that were never possible, even just a few years ago.

**CEOCFO:** *Your site indicates Craitor offers intuitive system, learned in minutes. How do you make it so easy?*

**Mr. Shnell:** Part of it is that our system automatically adapts to various environmental conditions through its sensor suite. It is able to both track its internal operating conditions and its external operating conditions, through various sensors. The benefit of that is that we can optimize and automate part of the printing process, that it would require a very attentive operator to know. For example, if you deployed this in the middle of the desert, and you had over almost 100 degrees of temperatures going throughout the day, as a 3D printing operator, you would have to know how you need to modify parameters, how you need to protect it, you would essentially put it in a laboratory type of environment. Our system does not require that. It does not require the training to understand that, and it does not require the protection of some kind of shelter, to be able to continue reliably and consistently, to print through a temperature swing like that.

Part of it is also using pre-learned software, essentially. Therefore, we are using a software program that, on the front end, that is very similar to anyone who has had any experience with 3D printing, to be able to use. It is very simple. I walk people through it if they need a little bit more hand holding, and it does a little bit of thinking in the background, to try and allow an operator to make the best possible part with minimal amount of training.

**CEOCFO:** *Would the DOD be making one part at a time, or the need for one specific part? Would they need 200 of something and work on that? What has been tried and what might they be looking to do?*

**Mr. Shnell:** Primarily for our type of system, it would be one at a time. It would be very specific parts, maybe a few at a time, but it would be specific parts that are needed in the field at the time and would mostly be used to support expeditionary elements. Therefore, I do not see them printing 200 of a part in the field, but they would probably take that with them, unless they really needed it. They could if they needed to! The place that I picture them actually doing that, and deploying 3D printing in that capacity, is at the depot level, at least for a larger operating base location, to enable them to use larger 3D printing systems that would not traditionally be expeditionary and be able to print this large quantity of parts for distribution amongst various different units, potentially.

We want to work hand in hand across the DOD, at all different levels of deployment, to provide various levels of capability. On our current system, it is never going to be the best option for mass producing 3D printed parts, because it has not been built to do that. It has been built for the field in which one, two, three parts that are critical to mission success are able to be printed in environment, when and where they are needed.

**CEOCFO:** *What does the next year or so look like for Craitor?*

**Mr. Shnell:** This next year is going to be very busy. We are currently in the process of raising our first, what is traditionally called, a seed raise, to get to production to target programs of record that become available in the fiscal year 2023. We are meeting with various different partners and groups to help develop that production, to help fundraise that production, and then help get this into the hands of our warfighter. In fact, in the short term we are looking to expand the services that we test with and deploy with, and to be able to take it beyond just the Marine Corp.

The Marine Corp has taken the lead of the deployment of printing, especially expeditionary. They are our expeditionary force, and we are looking to expand that to hopefully include the Army, the Air Force, and the Navy as well, and all the various different services.

**CEOCFO:** *What do you understand, what have you learned about working with the government?*

**Mr. Shnell:** I have learned a whole lot! As I mentioned, I originally started out as a student researcher out UC San Diego, and I had a very basic, broad understanding of the US, DOD, the general DOD, and not only just how they operate on a day-to-day basis, but how concentrating mechanisms work, and the like. I will be honest, many of my early start-up

days were, not just learning how to found a company, because that comes along with it, too, but also how to build a DOD company. What requirements do we have to make to meet our requirements and like, what requirements does our product have to meet? Even if it hits everything in regard to capability, what boxes does it need to check, so that it is open to be used on the various networks and the like.

It really has been a little bit of drinking-from-the-firehose, but I have been very lucky to have advisors who are all experienced, many of them veterans themselves, and members of our team who have lived and breathed the DOD ecosystem, both on the contactor side, and from the warfighter's side. Therefore, I basically absorbed from there, and learned about what we need to do to essentially make this product a reality, make it more than just a prototype that one unit uses and then falls into obscurity. How do we really provide a capability that we believe that we are heading towards, and really grow this additive manufacturing with the DOD, from a very foundational level.

**CEOCFO: *What, if anything, might potential partners, investors, people in the DOD miss about Craitor when they first look at the company, that really should be understood?***

**Mr. Shnell:** Our company is more than just a printer in a box. Mechanically, our printing has more inclusions into it that are unique, that are part of our technology and our capability, that allows us to do what we do better than anyone else on the market. However, fundamentally, we are also more than just a 3D printer company. We have built more than just the 3D printer.

We are bringing together, different companies, partners, to form this ecosystem, to build what we believe to be an entire additive manufacturing capability across the entire DOD. Our 3D printer is really just the tip of the spear.



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