ATHANASSIOS KALIUDIS

“With 3D printing, the powder is the key”

Phil Carroll saw the need for a specialist AM powder business viewing the process from the perspective of the powder. Seven years later he is taking control of the key challenger to AM – the devil particle.

When did it first occur to you that manufacturing metal powder was a good business idea?

It was more of a development than a decision. While I was writing my doctoral thesis back in 1999 at The University of Sheffield, I was focused on metallurgy. I was investigating how metals behave when their states change from liquid to solid. After that, I did a lot of work with laser metal disposition – LMD – at The Welding Institute in England and worked closely with Fraunhofer ILT in Aachen. In 2007 I founded LPW Technology as a one-man business, working as an engineering service provider. During one LMD project for Lufthansa Technik, it occurred to me that, in fact, it was irrelevant how good the machine and process is – the tipping point is in the metal powder. In other words, if you put garbage in, you’re going to get garbage out.

That’s not exactly a new idea.

No, of course not. But the engineers had neglected this aspect in favor of tinkering with the machines and processes. I think that’s because people working in conventional metal processing are no longer in the habit of thinking much about the material. Semi-finished products have improved continuously over the past hundred years. There’s a list of specifications – you look at the list, determine which materials on the market fulfill your requirements, and then you buy the most economical one. Very easy. People forget that the material itself is the key.

» **Engineers have neglected the materials aspect for some time.**

So what made the metal powder “garbage,” as you put it?

We simply didn’t know enough about it. We didn’t know the variables that influence the process. There were no parameters

to look to for comparison. It was like baking a cake without a recipe. With 3D printing, where you make a component directly and completely from powder, this was an even more obvious problem than it was with LMD.

And that's why you started up your own company: to make better metal powder?

Yes and no. I'd started up my one-man business, LPW Technology, five years earlier. But in 2012 I decided to concentrate my efforts on powder. I hired people and rented space. One advantage of this was that I could finally take someone on who knew how to build up a business. I think I'm a pretty good engineer, but I've never really been one for dealing with all the business matters that go hand in hand with owning your own company. I had personal reasons to go that route, too: as a freelancer, I spent a lot of time abroad, mostly in Germany. In 2012, I'd had enough. I had a wife and kids and I wanted to be at home with them.

Phil Carroll was awarded the Queen's Award by David Briggs MBE, Her Majesty's Lord Lieutenant for Cheshire, in recognition of the company's exceptional overseas expansion. Picture: LPW Technology

How did you launch your new company?

I have to admit we had a rather unusual start. Normally it goes like this: you get into the powder business by manufacturing powder and then selling it. But we didn't produce even a single particle in our first year. I wanted to be sure that we truly understood metal powder – better than anyone else did! So, the first thing we did was set up a lab. And then we examined the delivery chain very carefully to identify where the weak points were.

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What did you study?

We analyzed every existing metal powder in the world and focused on the post processing. We wanted to find out how to control the shape and size of the particles. How to ensure we can ultimately share out a batch of alloys completely evenly across all containers? We were also determined to consider things from the perspective of the end application. We didn't want to come across to our customers like a supermarket – here's the powder, take it or leave it. Instead, we ask customers what problems they face, then we develop the powder that's right for the application. You have to know a lot to do that. It's quite tricky.

Can you provide an example of why that's so tricky?

The first thing that comes to mind is the devil particle.

Devil particle?

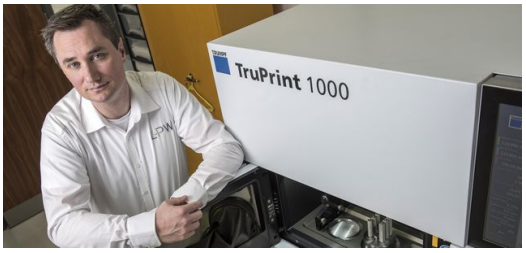
That's what we call it at LPW. There are two billion particles in just one kilogram of powder. How can you be sure that it's 100-percent free of contamination, that it doesn't contain a single devil particle? Ask someone in aerospace how much is a safe level of powder contamination, and they'll answer "zero." Okay, after a few beers they may say "we don't know definitively." but officially it's always zero contamination. We look at every possible way powder could become contaminated, for instance during manufacturing of the powder itself, storage, transport, handling or on the 3D printer's powder bed during the production process, because there might be a residue of another powder there. But the greatest risk of contamination comes from reusing powder during 3D printing. It's easy for a hair, some skin cells or whatever to get in.

So with 3D printing, it's better to not reuse powder?

No, that can't be the solution. In economic and ecological terms, 3D printing on a viably commercial scale would be totally ludicrous if you had to throw away any leftover powder on the powder bed. But customers do need to be aware that after ten or twenty powder rounds, their components will be affected. Even if you could keep the powder completely pure, any particles that are simply "grazed" by laser beams or just happen to be near the melted particles will have had their surface characteristics altered. That's why we offer software that takes over quality management for the recycled powder. The data for this software comes from our own experiments, analysis and understanding of the process.

Who are your customers?

Right from the start, we've focused on aerospace, medicine, gas turbines, Formula 1 and high-end users. Our customers still come from these safety-critical industries.



In 2007, Phil Carroll began working as a freelance engineer. In 2012, he decided to hire other people, and entered the powder business. Today his company employs over 75 people at five locations. Picture: Paul Cooper

Those are all industries with extremely high quality and safety requirements. As a young company, isn't it a bit bold to start here?

It's true that the criteria for shape tolerance and contamination in those industries are truly very strict. And it was a long hard road to get there. But I made the deliberate decision to start with something difficult, with aerospace. If we can meet their standards, then we can meet everyone else's, too. But there's a second reason: there's nothing I love more than airplanes. I like going to air shows or just hanging out at airports. I'm mad about airplanes. And the technical requirements for aviation have always impressed me. So, I started with something I love. That makes it fun and also easier to persevere.

Do you have tips for people wanting to start up a company?

Know your weaknesses. Hire people that are better in those areas than you are. And: let go. Create a structure in which your employees can make their own decisions. Any boss who insists on having a say and being involved in everything will eventually become a bottleneck that irritates everyone and slows them down. Oh, and I have another tip, but it sounds a bit clichéd.

» Never try to fulfill the money-men's dream!

Please, let's hear it!

Make sure that you live your dream. Building up a technology company is not cheap. You need to borrow a lot of money from others to get started. But then, of course, investors and banks want to be involved in the decision-making – it's their money, after all. So there's this danger that you'll do what the investor thinks you should, and not what you yourself think you should. You really have to watch your step. My advice is, never try to fulfill the money-men's dream if it's not in step with your own!

LPW Technology, located in Runcorn near Liverpool, produces special, high-quality metal powders for safety-critical, high-grade additive manufacturing application for aerospace, medical, automotive and turbine construction customers. It also provides all kinds of services related to metal powder as well as a software solution for quality management. LPW produces in the UK and the United States and has additional sales locations in Germany and Italy. A research and software center recently opened in the UK. In 2016, the company was honored with the Queen's Award for Enterprise.

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