

GKN Powder Metallurgy: Moving metal Additive Manufacturing towards mass production with HP

With the launch of HP's new Metal Jet system, Binder Jetting looks like the technology that will help move metal Additive Manufacturing into the realms of mainstream high-volume manufacturing. GKN Powder Metallurgy is set to be the first global parts manufacturer to move into mass production with this technology and, in the following report, the company outlines the evolution of its AM operations to-date and its expectations for the future.

With metal Additive Manufacturing poised to disrupt a \$12 trillion manufacturing market, manufacturers and investors are now wondering what processes, materials and industries they should be watching, and how the seemingly radical processes that comprise metal AM will succeed in entering the manufacturing mainstream.

Firstly, it is important to understand that Additive Manufacturing is only one 'tool in the toolbox' and it will not fully replace conventional manufacturing processes. However, with the speed that metal AM is moving, it is set to transform a wide range of industries and industrial processes to the extent that companies which do not adopt the technology could quickly lose a significant competitive advantage.

A major development in the AM industry has been the recent announcement of HP's Metal Jet system (Fig. 1). Claiming to be up to fifty times more productive than comparable AM methods, the launch could represent a significant change in the market. In addition, it is said

to be nearly half the cost of other Binder Jetting systems. However, anyone in manufacturing knows that equipment is only one part of the solution; understanding how to use new technology and having a sustainable and efficient supply chain are other vital parts of the jigsaw that must all come together for success.

In order to bring all of these pieces together, HP collaborated with Volkswagen and GKN Powder Metallurgy. The partnership's broad ambition is to challenge conventional manufacturing, remove design barriers and accelerate the adoption of metal Binder Jetting technology - particularly for automotive and industrial applications.



Fig. 1 The HP Metal Jet system is HP's first metal AM machine and is said to provide up to fifty times higher productivity at a significantly lower cost than other Binder Jet and Powder Bed Fusion technologies (Courtesy HP Inc.)



Fig. 2 Peter Oberparleiter, CEO, GKN Powder Metallurgy

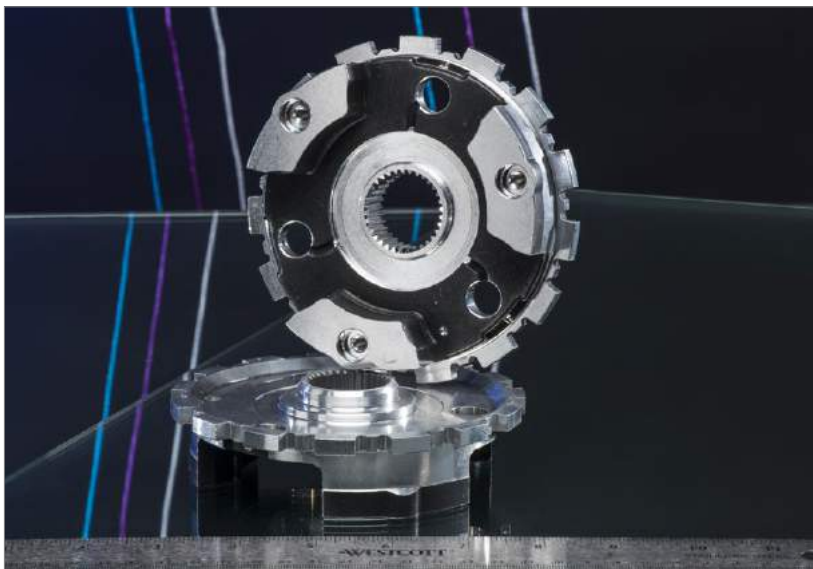


Fig. 3 GKN Powder Metallurgy manufactures 13 million sintered parts per day. These 2018 MPIF award winning aluminium PM planetary reaction carrier components, produced for General Motors, are good examples of the company's PM products (Courtesy MPIF)

During the 2018 International Manufacturing Technology Show (IMTS) in Chicago, Illinois, USA, GKN Powder Metallurgy announced that it will be the first to deploy the newly-launched HP Metal Jet at its factories to produce functional metal parts for companies including Volkswagen and Wilo. GKN stated that its goal with this system's deployment is to drive the global industrialisation of AM, transforming new product

development and manufacturing, reducing the time-to-market for mass-produced parts from months to weeks, lowering development costs and providing greater design and manufacturing flexibility.

"Our vision for industrial Additive Manufacturing moves beyond prototypes and small-series production and into mass production. We see a future where every modern digital company will have cutting-edge AM

machines in its facilities, enabled by GKN technology, design and support to produce metal parts in twenty-four hours," stated Peter Oberparleiter, CEO of GKN Powder Metallurgy (Fig. 2). "This strategic partnership with HP is the tipping point to accelerate that vision. As we join forces with them, we want our customers to challenge us to break design barriers and accelerate the adoption of Binder Jetting technology as an exciting complement to our existing Additive Manufacturing offerings."

As the world's largest producer of metal powder-based parts, GKN Powder Metallurgy is uniquely positioned to advance the development of the Binder Jetting industry. By integrating the HP Metal Jet system into its plants worldwide, GKN Powder Metallurgy hopes to leverage its metal powder expertise to engineer new powders based on customer needs and help its customers design parts they did not realise were even possible. In this way, the company expects to build on its foundation of manufacturing thirteen million sintered metal parts per day (Fig. 3), continuing on the path to Industry 4.0.

Commenting at the time of the partnership announcement, Stephen Nigro, President of Additive Manufacturing at HP Inc, stated, "HP is proud to partner with GKN Powder Metallurgy to bring the power of 3D mass production to the largest industries on earth, such as the auto and industrial sectors. The combination of HP's breakthrough Metal Jet technology and GKN's engineering and manufacturing leadership promises to enable the production of millions of high-quality, low-cost additively manufactured final parts."

The missing piece of the jigsaw

GKN has been involved in Powder Metallurgy for nearly eighty years. During this time it has amassed experience not just in the science behind the technology, but in working closely with customers and partners



Fig. 4 A state of the art shop floor at GKN Powder Metallurgy

to understand the entire process, from raw material to the application and the performance demands of the final product. "Powder production and metal part processing are part of our DNA," stated Oberparleiter, "and we have a long history of collaborating with customers and industrialising solutions that bring great benefits to the entire industry."

With a large footprint in both metal powder and part production, GKN Powder Metallurgy believes that it is its experience and global network that enable new customers to feel comfortable working with innovative technologies. "In order to build the business that we have today its taken very close collaboration with customers to design the best metal powder solutions for their products," explained Christon Franks, President Commercial, GKN Sinter Metals. "For partners such as HP and customers such as Volkswagen, I think that we're the missing piece of the jigsaw. We take the best technology from machine builders, we industrialise it, raising the process to the highest

quality standards and, as a result, we are able to give customers and partners full confidence in new technologies." It is these elements, states GKN, that will act as a foundation as it builds its presence in the AM industry.

The move into metal AM

Commenting on how Additive Manufacturing has influenced GKN's go-to-market strategy, Franks told *Metal AM* magazine, "Over the past few years we really started to understand the capabilities of AM and the attractiveness of the marketplace. Initially, we looked at getting into AM to expand our current portfolio of metal powder-related technologies. You need the right combination of application requirements and volume to make products eligible for conventional PM, so we were looking to expand our portfolio to move into lower-volume programmes, products and applications that were simply unsuitable for PM."

"As a starting point, we moved into AM to replicate the same types of shape that we manufacture in PM, but servicing different markets and volumes. However, as we progressed into higher-volume AM, particularly using laser-based AM for external customers, we started seeing designs coming in that weren't 'PM friendly'. As soon as the designer was free of the restrictions of conventional processing, we saw geometries that really surprised us. It was actually the marketplace, and the new creations that designers were asking for, that changed our perspective on how to use AM. It's interesting to see this unexpected shift, but that is how you know something exciting and big is happening," he stated.

Commenting on what GKN's developments in AM mean for its existing customer base, Franks added, "I already mentioned the design flexibility. We already have customers that use powder bed AM to create optimised parts that were originally designed for conventional manufacturing processes. Now, with



Fig. 5 Christon Franks, President Commercial, GKN Sinter Metals



Fig. 6 A high-precision, high-strength metal part produced using HP's Metal Jet system

Binder Jetting, we can offer customers a similar design freedom whilst significantly increasing production volumes."

"Metal Additive Manufacturing offers a fast product development time compared to conventional technologies, and this is a big part of the overall flexibility the process offers. Not only does it offer design flexibility, but manufacturing flexibility; you can

move through iterations faster for prototyping, and you don't have to wait on expensive moulds that can take a lot of time and cost. As AM grows, we are seeing it used in higher and higher volumes. Without the need for tooling, we limit any incumbent inertia. This flexibility in design and manufacturing is driving innovation, with powder metal AM leading the charge."

Franks believes that whilst GKN Powder Metallurgy's AM capabilities have allowed it to broaden its customer base, the technology has opened new markets for existing customers. "Whilst we've picked up new customers along the way, the reality is that the customers that are benefiting the most are our established customers. Some of the traditional markets are starting to see major shifts. For example, in the automotive sector, electrification and other industry trends are resulting in a more fragmented market and a move towards fewer global programmes and more regional programmes. When this happens, customers don't necessarily have the same need for industrial scale production, so what we're able to offer is a quick way to introduce products and adopt new, innovative processes."

"As the market moves faster, even becoming more decentralised, the metal-based AM solutions that we deliver give our customers in the automotive and industrial sectors the speed, flexibility, volume and customisation necessary to keep up with the shifts that we have continuously seen in the market for years."

The challenges ahead

Commenting on the challenges to implement such radical shifts, Franks stated, "The first challenge is the market itself. As previously mentioned, it's constantly changing, and you need to have the flexibility to move with it. The second challenge is the customer. We've been spending an incredible amount of time training our customers over the last two years as to what AM, both laser and binder-based, can and cannot do. Once a customer has a deep understanding of what AM can do, you are then able to work with them to push the capabilities of the technology."

GKN believes that companies should consider both prototype and aftermarket volumes together to recognise the full value of AM adoption. "It is important to funnel all low-volume purchases through one



Fig. 7 Designing for metal AM at GKN Powder Metallurgy

door within an organisation, to see what kind of volume collectively, or demands collectively, their company has.”

A further challenge is that of safety and quality. “When it comes to a new technology, industries are naturally concerned about safety as much as they are about the quality of products produced. We’re lucky to work collaboratively with early adopters and can manage expectations. For example, Volkswagen knows it might take a couple of generations to see the full benefit of a new technology, and they understand they are early adopters of a truly innovative AM strategy.”

The future of metal Additive Manufacturing

Commenting on the growth potential of metal AM, Franks stated, “In five years, more companies will learn and become comfortable with powder-based AM technology. There

is still a large market that hasn’t adopted AM for prototyping, for example. Companies will continue to adopt AM for prototyping as the costs reduce, which will expose more designers to the benefits of the technology. GKN believes that this added exposure will push forward the validation of the technology and, as more limitations and benefits are understood, AM will edge further into the mainstream for mass production.”

“Factories will combine traditional PM with a growing AM department which will ramp up both Laser Powder Bed Fusion (LPBF) and Binder Jetting. After a period of validation and exploration, the future will become even more exciting; as designers continuously push to do more with less, the design freedom of AM will offer solutions which do not yet exist. When designers have less limitations and are free to optimise a part in any way they see fit, this is when we will see AM change the world.”

From a consumer perspective, GKN states that new products will become available with capabilities that simply weren’t possible before, and that these products will be introduced much faster than in the past. “This will only create more demand for customisation and decentralisation, which could reduce the overall volume needed from traditional manufacturers. In addition, it will force companies lagging behind to adapt or potentially lose market share,” stated Franks.

Imperative to this future will be the development of an integrated supply chain. “About five years ago, manufacturers using metal powders reported that it was difficult to get the right alloys, powder grades, or quantities that they needed. Today, with suppliers such as GKN, a wide range of powders are ready and available for production-sized orders. For example, GKN produces multiple titanium and steel alloys in quantities suitable for high-volume production. In addition, if a customer needs a custom alloy to



Fig. 7 Guido Degen, GKN's Senior Vice President Additive Manufacturing & Business Development

achieve specific material properties, GKN has the knowledge, experience and capability to produce custom batches quickly while meeting or exceeding quality standards," explained Franks.

"But it's not all about what and how much can be produced. Metal AM will also shorten time to market, which means feedstock replacement will have to happen faster too. Partnering with a company such as GKN, with the experience and extensive network to move high-quality powders quickly, will be another key to success in powder-based AM. GKN is already delivering high volumes of powders to customers around the globe in multiple markets."

Moving to mass production

AM systems such as HP's Metal Jet lower the barrier of entry into the AM market and decrease the amount of time before adopters see a return on investment. The range of volumes at which AM is more economical than traditional processes will increase. "This will of course also depend on the part, and if it is fully optimised for the process. Currently, experts are targeting parts produced at around

10,000–50,000 parts per year to be optimised with AM," stated Franks.

"People ask how long it will take to see AM really take off. Depending on who you are, you might say it already has. With every month that goes by I get more bullish about how I answer this question: I see our activity increasing exponentially each month, and I want to move the market for AM mass production closer and closer to today."

GKN has already, from the perspective of laser-based AM, created an industrial footprint to serve customers and is seeing tremendous volume come through for binder jet. However, the true industrialisation of AM, whether using binder or laser-based technology, has not yet been fully accomplished, and this is one of the biggest challenges faced in implementing this technology into an existing supply chain. Guido Degen, Senior Vice President Additive Manufacturing & Business Development, stated, "I'm confident that we're already well-prepared, given our existing digital framework. In addition to that, GKN has a broader vision for Additive Manufacturing becoming a global player in the market."

In addition to an expansion of its Binder Jetting capabilities, GKN will also enhance its relationship with EOS GmbH to develop the Laser Powder Bed Fusion process towards mass production. "The laser process offers huge potential in material, design freedom and productivity. EOS and GKN have the capability and expertise to drive industrialisation within this technology branch. This will be showcased to the public as a joint approach during Formnext 2018," Degen stated.

Outlook

As GKN discovered when it began its exploration of Additive Manufacturing, it will ultimately be the market that steers AM and the early adopters that have the potential to gain the greatest competitive advantage. But how big are the potential wins these companies are targeting? With a manufacturing market valued at some \$12 trillion, industry analysts predict rapid growth for the Additive Manufacturing sector. Although metal AM is currently a mere fraction of the total, the industry is following a dramatic growth curve, with metal AM equipment sales growing 875% in the last five years, and 220% in the last two, according to the *Wohlers Report 2018*. Continued rapid growth could represent a bigger shift to come; perhaps, some say, the biggest we have seen since the industrial revolution.

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