TUNE IN, PRINT OUT

HOW A 3D REVOLUTION IS RESHAPING INDUSTRY

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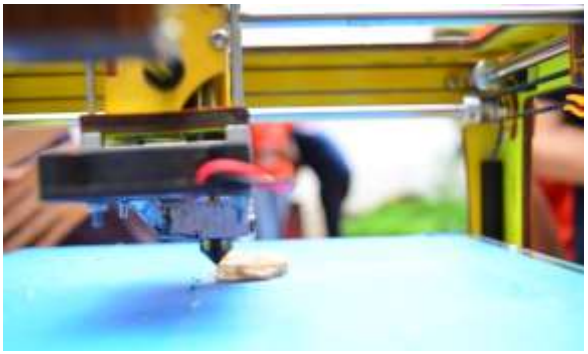
TUNE IN, PRINT OUT

Additive manufacturing is not new to industry. But it is the next frontier. As the price of 3D printing technology and metal powder drops sharply, more companies in Sweden are tuning into the opportunities. With up to 60 per cent reduced material waste, product and process innovation is limited only by the imagination.

When news broke in early 2016 that the technology giant Siemens was on track to invest €21.4 million in Sweden's first 3D printing workshop in the town of Finspång, less than 200 km south-west of Stockholm, it was a wake-up call for many manufacturers. At the very least, it indicated a turning point.

The art of making three-dimensional objects such as machine parts by "printing" thin successive layers of material – using metal powder – was clearly getting one step closer to wider adoption. Today, as prices of 3D printers and metal powder continue to become more affordable, some manufacturers are well ahead of the curve. 3D printing is rapidly migrating from customised Nike and Adidas sneakers, trendy headphones and hearing aids in the consumer market to highly complex industrial components.



These metal components produced in layers with CAD-models are often so complex in their design that they cannot be manufactured in any other way. And their impact is steering change – making surgical implants adaptable to human tissue over a lifetime, for example, and enabling the aviation industry to constantly push for lighter aircraft designs and more fuel-efficient jet engines, while ensuring they don't suddenly break down in mid-air.

In fact, additive manufacturing is now beginning to redraw the map of global competitiveness as companies like Siemens blaze a new trail in their factory operations. Moreover, Sweden is proving to be an attractive springboard.

A QUANTUM LEAP FOR GAS TURBINES

Everyone is talking about additive manufacturing, commonly known as 3D printing, which is not surprising considering the exciting opportunities that exist for product innovation and shortening of lead times. But Siemens' dedicated 3D printing workshop in Sweden was not established overnight. It was the culmination of a seven-year journey.

Hans Holmström, CEO of Siemens Industrial Turbomachinery AB, tells the story.

"We started with parts maintenance. Our technical experts discovered the potential of the next generation of 3D printing machines for metal objects. This led us to launch an experimental initiative looking at how parts could be repaired and made from scratch more efficiently, faster and at a lower cost using additive manufacturing," he says.

Holmström leads the tech giant's subsidiary for manufacturing of gas turbines used for generating electricity. The company has 3,300 employees working in Finspång, a municipality with a rich industrial heritage where turbines have been built since 1913.

Here, additive manufacturing is used to make components with complex shapes that enable internal air cooling among other advanced technical features.

"Developing a prototype was a process that used to take 18 months from start to finish. With 3D printing we have reduced that time to 4-5 weeks and the cost has also fallen dramatically.

Hans Holmström, CEO Siemens Industrial Turbomachinery AB

The gas turbines manufactured by Siemens have a capacity range of 5–400MW and play a crucial role in supporting the shift to renewable energy. Resembling the size and shape of jet engines, but without the large fan blades, they can be quickly deployed to feed electricity into the energy grid at peak demand or when the output of solar panels and wind farms is too low.

"3D printing is helping us to drive innovation. We now manufacture parts we simply couldn't make before, because they were too complex for conventional methods. When you take cost savings and sustainability benefits into account, additive manufacturing really opens up a new dimension. We use half as much material today in our parts manufacturing operations. This means a 50 per cent reduction in material waste, just by switching methods."

Siemens' additive manufacturing facility in Finspång.

Source: Pictures courtesy of Siemens

But that's not all. In terms of process innovation, using 3D printing machines for prototyping has enabled Siemens to make a quantum leap in efficiency gaining speed to market.

Holmström continues: "Developing a prototype was a process that used to take 18 months from start to finish. With 3D printing we have reduced that time to 4-5 weeks and the cost has also fallen dramatically. Today we encourage all our design engineers to test as many crazy ideas as possible, to explore dream concepts they previously knew were too risky for expensive prototyping."

In addition, as Holmström points out, the use of additive technologies has now fully transformed the way spare parts are serviced at the Finspång site. Instead of discarding entire sections of, for example, a burner in a combustion chamber, they are shaved off sparingly and 3D printed back into place – just like new – which again saves valuable time and "huge volumes" of material.

"3D printing is reminiscent of nature's own design solutions and this is evident if you examine the bone structure of birds. That's what makes it so fascinating," he says.

NEW HORIZONS IN METAL

So which stepping stones enabled Siemens to set up shop and launch a rapidly expanding series of 3D printed components? How can other companies tap into the potential of additive manufacturing as the phenomenon gains momentum?

Another successful Swedish company which is making its mark internationally can help provide the answers.

From its factory in Mölndal, in the district of Västergötland, Arcam AB offers a range of 3D printing machines for metal-based additive manufacturing. The company's Electron Beam Melting (EBM) process resuls in fully dense and durable metal components and has attracted attention from customers, the media and investors alike. In 2017, it was announced that the multinational conglomerate General Electric had purchased a controlling stake in Arcam.

"Additive manufacturing will completely replace titanium casting for implants over the next ten years. We are working towards that goal."

Magnus René, President and CEO, Arcam

Source: www.siemens.com/press

Arcam was founded in 1997 in the early days of 3D printing when engineers and industrialists were mainly focused on prototyping. But according to its President and CEO Magnus René, a more ambitious future was always part of the plan.

“Our mission from the outset has been to provide 3D printing technology for mass production of metal objects and not just making prototypes, although our machines do that too. Our first machine was sold to a university in the U.S. in 2003. A few years later our customers first began to use our EBM technology in factory operations, which was an important milestone.”

TAKING OFF IN AVIATION

Arcam’s machines for additive manufacturing are mainly sold to customers in two key sectors – the aviation industry, where they are used to accelerate innovation in the design of jet engines and aircraft, and the medical industry, where 3D printing is used to create implants with structures that integrate better into the bone.

Magnus René sheds light on the rise of additive manufacturing by busting a few myths.

“Additive manufacturing will definitely revolutionise the market in terms of how companies make parts with highly specific designs that can add value or enhance the performance of machines. But it will not spell the end of traditional manufacturing which, in many instances, is still more economically viable.

“Having said that, I believe that additive manufacturing will completely replace titanium casting for implants over the next ten years. We are working towards that goal,” he says.

René estimates that 10-20 per cent of all medical implants are currently manufactured using additive technologies using standardised designs. This figure, he predicts, could quickly rise to 100 per cent of the market.

More than 50 per cent of all new hearing aids are produced using 3D printing technology.

But the potential of the aviation industry is fifty times greater for Arcam than that of the medical industry.

In short, the company's CEO is getting ready for take-off.

"There are many components in jet engines that are roughly the size of a coffee cup. They can all be 3D printed to enhance performance, reduce weight and save costs. The boundaries are also being pushed continuously in the structural design of airplanes."

SWEDEN OUTLOOK: 3D – THE INNOVATION LAUNCHPAD

While the majority of all hearing aids are currently produced using additive manufacturing, 3D printing of metal components for industrial applications is only in its infancy. However, as explained in a recent Gartner forecast, big wheels are in motion. 3D printing has migrated from being a niche activity and now plays an important role in augmenting a broad range of manufacturing processes.

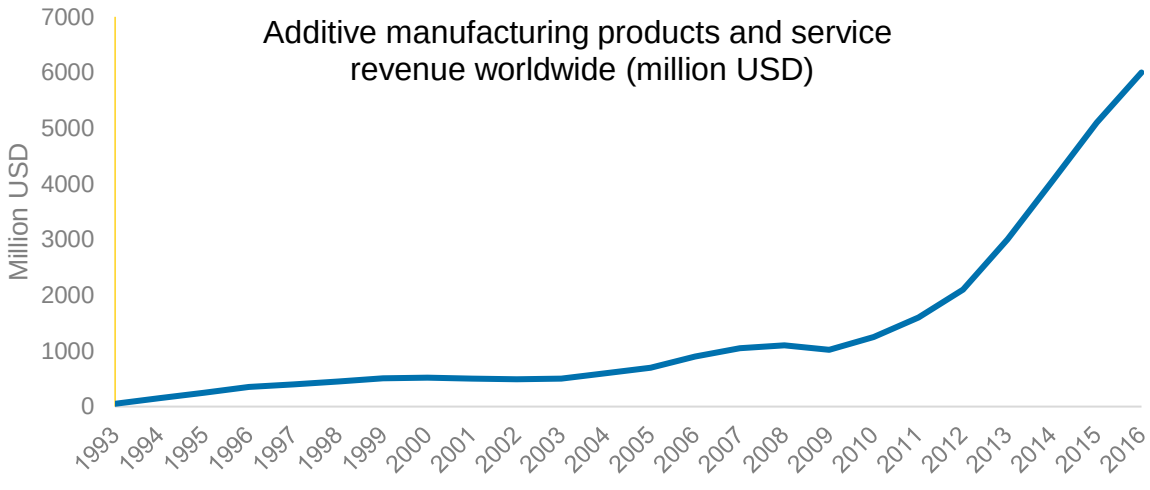
By 2020, the report says, as many as 65 per cent of all manufacturers that expect to use 3D printing will be doing so to produce and service components for the products they sell. Statistics from Wohler Associates show that the global market for additive manufacturing products and services has grown by 570 per cent in the past seven years.

Sweden, a country which is rich in metal raw materials, has only recently begun to make up for lost time in the thriving arena of 3D printing. But according to Babak Kianian, mechanical engineer and PhD candidate at Lund University, there are promising signs of progress on the horizon.

Says Kianian: "Education will be key to this technology shift in Sweden. We are just starting to see the types of cross-functional collaboration initiatives emerge that are essential if Sweden is to compete with other European countries. Companies, universities and government agencies like Vinnova are coming together and sharing ideas, expertise and resources."

570%

Global revenue growth in additive manufacturing industry since 2010



Source: Wohlers Associates, Inc. 2017

One of the most active collaboration initiatives in Sweden is funded by the government and lead by Hans Holmström. He agrees with Kianian that re-education is the key to putting additive technologies on the fast track. “3D printing is the very definition of digital manufacturing. In our workshop, even the process itself is documented with intelligent cameras and automated alarms that allow us to safeguard quality at every step.”

A recent report from industry analyst MarketsandMarkets confirms that 3D printing is one of the fastest growing areas in the manufacturing sector today. It underscores that a shift from prototyping to batch and mass production is already underway. And that the global market is expected to grow by 27 per cent annually until 2023.

The next phase for manufacturers, says Babak Kianian, will be to move from mass production to mass customisation of products and shorter value chains. But industry leaders, he points out, need to keep in mind that 3D printing is a complimentary method. They should use it to their advantage firstly by building a business case for their operations.

Furthermore, considering the environmental challenges the world is facing and increasingly strict regulations being introduced, additive manufacturing is a no brainer.

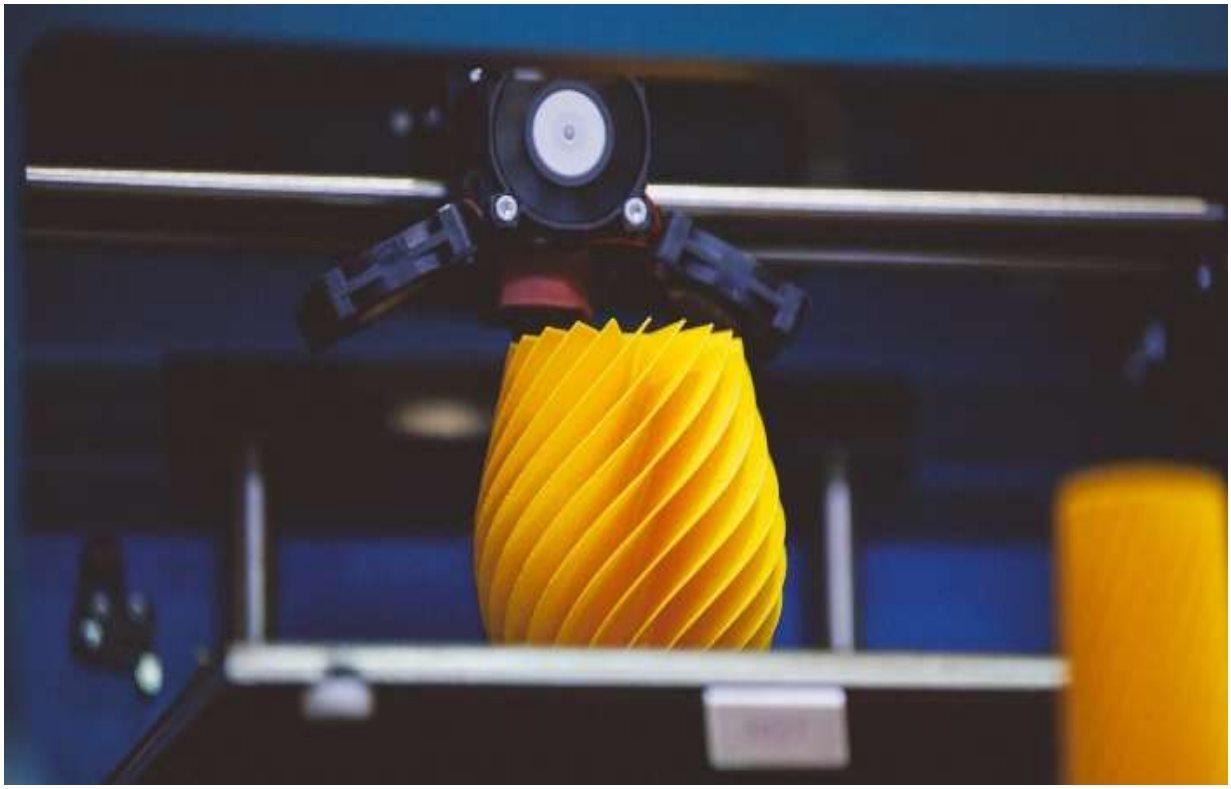
“We are just seeing the tip of the iceberg for 3D printing,” Kianian concludes. “Metals is a huge growth area for multiple reasons. In traditional manufacturing where you subtract materials, you typically end up with 50-60 per cent raw material waste. With additive manufacturing you can reduce that waste figure to 3 per cent. 3D printing also allows you to reduce the weight of components by 30-40 per cent and still improve their mechanical properties.

“I am very hopeful that we’ll see more 3D initiatives going forward, more university courses, crash courses for young professionals and that more companies use Siemens, Arcam, Sandvik, Höganäs and other players as a benchmark. That would be a good step.”

Inspiration is easy to find among the frontrunners. But to capture the full potential of the 3D printing revolution, which is just around the corner, top management need to promptly re-assess the future. When big ideas gain traction – a first class network of sub-suppliers in Sweden is waiting in the wings.

“We are just seeing the tip of the iceberg for 3D printing.”

Babak Kianian, mechanical engineer and PhD candidate at Lund University



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Smart Industry is the Swedish government's strategy for industrial renewal. Launched in 2016, the initiative aims to strengthen companies' capacity for change and competitiveness, promote research and facilitate the transition to data-driven and sustainable production of goods and services. In this strategy, Business Sweden has the government's assignment to promote, support and attract industrial investments to Sweden.

Sources:

1) Gartner, Forecast: 3D Printers Worldwide 2016
2) Wohler Associates Inc, Wohlers Report 2017, 3D Printing and Additive Manufacturing, State of the Industry
3) Markets and Markets, 3D Printing Market by Offering, Global Forecast to 2023
4) www.siemens.com/press, 2017

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