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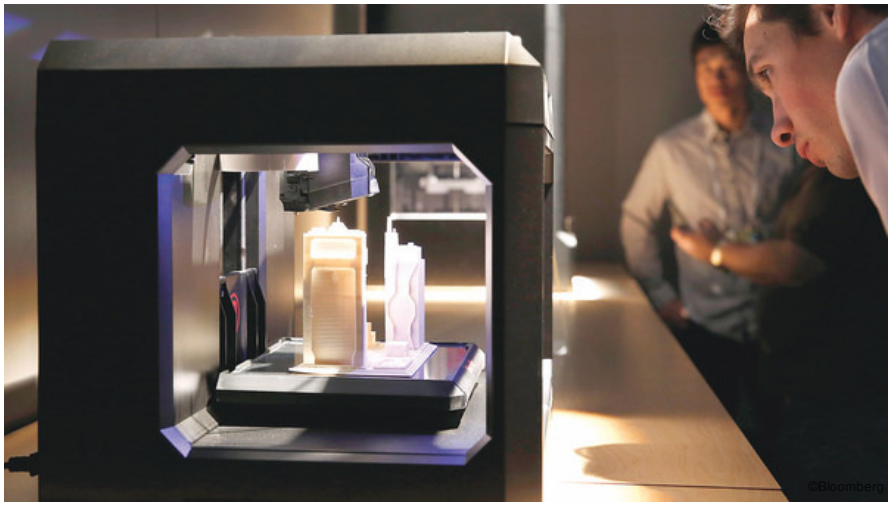
3D printing: Additive process lays it on thick

By Paul Solman



Layer player: a Makerbot 3D printer on display at this year's Consumer Electronics Show in Las Vegas

Imagine a structure to suspend street lighting – a complex web of metal struts and high-tension cables, linked by steel joints.

It was an innovative design but the problem for Arup, the engineering group that developed it, was the joints, or nodes. Each had to be slightly different, making manufacture time-consuming and costly.

Then the company hit upon the idea of using a 3D printer.

The process – also known as additive manufacturing – has been around for a quarter of a century, but only in the past few years has it become widely used by both industrial manufacturers and consumers.

This expansion has been boosted in part by the availability of cheaper printers and by the possibilities offered by new materials.

The global market for 3D printing grew last year by about 35 per cent, or more than $3bn, the highest compound annual growth rate in 17 years, according to Wohlers Associates, a 3D printing consultancy.

Where once the popular imagine of 3D printing was plastic guns, the technology can now create anything from jewellery and furniture to dental products and parts for nuclear facilities. The future is likely to see 3D printing of food and artificial body organs.

Printing in metal is one area that seems to have captured industrial groups' imagination, and users of the process include Siemens, General Electric and BAE Systems.

"In some ways, metal printing has developed further in the past 10 years than plastics have in the past 25," says Terry Wohlers, president of Wohlers Associates. "Metal printing is still too expensive for the automobile industry, but it's very affordable for industries such as aerospace, and many types of metals can be used."

For Arup, even 3D printing did not present a simple answer to producing the nodes for the street lighting project.

"The 3D printing industry is not used to working with the building industry, so we needed to find out how to implement the design freedom and production restrictions in our design," says Salomé Galjaard, the senior designer at Arup who led the company's 3D printing project.

"We still have much to learn about how to use 3D printing for building in terms of design and production


3D-printed chocolate

and the structural behaviour of printed products."

Nevertheless, Arup was able to create nodes in a lightweight and complex design printed in maraging steel, which is strong but also has good machinability.

"I doubt that all building projects would benefit from 3D printing in the future," says Ms Galjaard, "but it has big advantages in design freedom, where form can follow function, bringing weight reductions that can also reduce costs."

Another area raising expectations is the use of 3D printing in medicine to create, for example, organs for transplant surgery. The possibilities are enormous, but experts caution there is still much work before it becomes a reality.

"It's still very much in R&D," says Mr Wohlers. "The idea of printing hard and soft tissue has been around for some time, but we are still quite a way from commercial viability.

"There are still a lot of problems to be solved with printing skin and tissue for hearts, livers and lungs. Even [leading medical experts] wouldn't commit to that happening in our lifetime."

Closer to fruition may be the 3D printing of food. The additive manufacturing technology can be used along with other processes to mimic existing products or create something new.

"There are a lot of possibilities in food structures," says Wil Schoenmakers, global head of consumer products at PA Consulting, which is printing food at its Cambridge Technology Centre in the UK.

"We can put together ingredients that would normally be incompatible with conventional techniques. It also allows us to use air to create textures and create a different experience."

There is also huge potential in creating customised products, tailored to the consumer, he says.

Mr Schoenmakers thinks the food industry is three or four years away from printing commercial food products on a large scale. PA has been working on 3D printed chocolates, and has made edible prototypes.

He adds: "Many food companies are looking to 3D printing to do it all, but it's not a single solution; it will need to be used with other technologies rather than on its own to produce food."

However, the growing number of industries that are finding a use for 3D printing suggests the process is moving closer to being an important tool for manufacturers.


Success is sweet: 3D-printed chocolates from PA Consulting

McKinsey Global Institute, research arm of the management consultancy, believes 3D printing could proliferate rapidly over the coming decade and could generate economic impact of $230bn-$550bn a year by 2025.

"I don't think there is any material that couldn't be printed eventually," says Jon Cobb, executive vice-president of corporate affairs at Stratasys, which makes 3D printers.

Stratasys specialises in plastics-based printing, and Mr Cobb says manufacturers are constantly challenging the industry to find ways of printing in more materials.

"Manufacturing companies want us to print using materials they are familiar with to meet their specific needs, so there is a growth in nylon and polycarbonate materials, some of them containing partials such as metal or glass," he adds.

Most exciting, says Mr Wohlers, is the boom in interest and investment in 3D printing.

"It takes a lot of money to make things happen, and governments and leading corporations are spending hundreds of millions of dollars on 3D printing," he says.

"That could accelerate development radically, and rather than waiting decades we could be waiting years."

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