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3D printing reshapes the factory floor

By Tanya Powley, Manufacturing Correspondent

3D printers can be used to create a wide variety of products, even a Christmas tree. This festive favourite has been printed out of super-hard special steel, the same material used to print parts of burners for gas turbines

For all the hype surrounding 3D printers and the potential for a new industrial revolution, their physical appearance is somewhat underwhelming. From the outside, the machines look more like large, American-style fridge freezers than props from a science fiction film.

However, it is the technology inside these bulky machines that has got industrial companies excited. At the press of a button, complex shapes are built up in layers from particles of plastics or metal. The result: a cheaper and faster way to produce complex products, some of which would be almost impossible to make with traditional manufacturing processes.

To date, companies have mainly used 3D printing, also called additive manufacturing, to make prototype parts and products for testing. But several of the world's biggest manufacturers, such as General Electric, EADS and Siemens, are now leading the way in moving the technology from the design shop to the factory floor.

From January, Siemens, the German electronics and engineering group, will use 3D printing to make spare parts and other components of gas turbines within its power generation service and maintenance division. It can produce more than 100 different individual parts this way. As a result, some repairs can be done in a tenth of the usual time.

"High-temperature turbine parts are probably one of the most challenging applications for 3D printing," says Nicolas Vortmeyer, chief technology officer at Siemens' power generation division. "It's not the easiest application of 3D printing because in turbo machinery you have some of the highest temperatures and stress and strains."

Siemens believes 3D printing could "revolutionise" the supply of spare parts. Today, spare parts are mass produced, stored and sent out individually as required. Soon they will be able to be printed exactly where they are needed – close to the customer.

For the aerospace industry, 3D printing is particularly attractive as it can produce lighter parts. In addition, the technology can also help reduce material wastage – important for an industry that uses high-cost metals such as titanium. As a result, products that have a poor "buy-to-fly" ratio are likely to be at the top of companies' lists for 3D printing.

"For some of our components you can throw away 90 per cent of the material that you buy," says Rich Oldfield, technical director of GKN Aerospace. "If you look at the bill of material on an aircraft, anything that has got a buy-to-fly ratio in that 70 to 90 per cent space is a candidate. That's a huge opportunity."

GKN, the British car parts and aerospace engineer, is developing a 3D-printed titanium bracket in Bristol with EADS, Europe's biggest defence and aerospace company by sales. This bracket can reduce machining time from four hours to 40 minutes and cut material use by 30 per cent. EADS is also looking at the potential to make larger, 3D-printed titanium parts, several metres in length.

GE Aviation of the US has also seen the potential benefits. From 2016, it will start producing its first additive component – fuel nozzles for the new Leap engine in the Boeing 737 MAX and Airbus A320neo aircraft. Each engine will contain 19 fuel nozzles. GE expects to make about 30,000 to 35,000 fuel nozzles a year by 2020, which will require between 60 to 80 3D printers.

According to Greg Morris of GE Aviation's additive development centre, a fuel nozzle currently consists of 20 different components that have to be machined, cast and welded. With 3D printing, it can be made in one metal piece, have five times the lifespan and weigh about 75 per cent lighter.

Mr Morris adds that there are a number of other 3D-printed engine parts that could start be mass produced around 2016.

Rival UK aerospace company Rolls-Royce has also signalled plans to use 3D printing to produce components for its jet engines, although it is a few years from entering production.

Even the companies actively using the technology admit the excitement about 3D printing has to be put in context.

A recent Morgan Stanley report downplayed 3D printing as a threat to traditional manufacturing. It found that the technology was mainly viewed by industrial companies as a prototyping tool, with 73 per cent using it for design compared with just 23 per cent for production.

"I think part of the problem is there's an impression that additive manufacturing is the answer for almost everything – [that] it's going to be less expensive et cetera," says Mr Morris. "That's really not true. It will be years until companies leverage additive in any substantial or significant way."

Terry Wohlers of the Wohlers Associates consultancy agrees that additive manufacturing will not usurp the current techniques. "You've got to look at 3D printing as another tool in your toolbox," he says. "If a new tool is invented it doesn't mean all your other tools go away."

Some of the main factors holding back mass 3D printing are the costs involved. Machines and the cost of the metal materials are high. In some instances, materials can be 50 to 100 times more expensive than traditional manufacturing materials, says Mr Wohlers.

Another problem is machine capability. Jon Meyer of EADS Innovation Works, the research arm, says: "Right now productivity is one of the biggest factors, the speed of the machines, to how wide the scope of adoption is.

"If I had a choice of doing one thing and waving a magic wand it would be to make the machines 10 times faster and suddenly you would have a huge market opportunity."

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Though the car industry is the second-biggest user of 3D printing after consumer products, according to consultancy Wohlers Associates – ahead of both medical and aerospace – for most car manufacturers the economics of using 3D printing for high volume mass production do not make sense.

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