Horizon
The EU Research & Innovation Magazine

European Commission

The promise of mass personalisation, on demand

Dr Phil Reeves, managing director of Econolyst, a global 3D printing consultancy, believes research needs to be coordinated across the EU to push forward 3D printing and give us mass-personalised goods made locally, on demand.

04 April 2014 - By DR PHIL REEVES

As someone involved in 3D printing for almost 20 years, I consider it both gratifying and overwhelming to see the level of interest the technology has stimulated within society, just a few short years after the media started to promote 3D printing as the catalyst for a 'new industrial revolution'.

However, like all great stories, the message often gets distorted and exaggerated each time it gets told. According to the popular press, before long disease and disfigurement will be eradicated by 3D-printed organs and limbs; aircraft will be ultra-efficient, burning almost no fuel due to the lightweight benefits of 3D-printed components; and transport and logistics infrastructure will become obsolete along with the traditional supply chain as consumer goods, clothes and even food are printed in our homes and communities.

There is no doubt that 3D printing will have an impact on many walks of life, from healthcare to warfare, computer gaming to consumer goods, and from recreation to education. However, as things stand this impact is more likely to be through the slow evolution of digital technology, rather than through some overnight game-changing revolution.

3D printing technologies were first developed in the 1980s and used by large manufacturing and engineering companies as a way of making models and prototypes directly from computer data. A 3D printer produces component parts by adding material layer-by-layer. It can do this by extruding molten plastic through a nozzle and depositing this accurately within the 3D printer, using lasers to melt layers of powdered material, or using inkjet printing heads to spray material into the shape of a desired part.

This technology was first termed ‘rapid prototyping’, as it allowed companies to make models within hours and days, rather than weeks or months. As the technology matured, models made in new materials could be made from plastics and ceramics through to metals and waxes. 3D-printed parts then found applications in other areas of manufacturing beyond prototyping, including the production of patterns used in the lost wax casting process and making cavity tools for injection moulding, providing a very useful addition to the engineer’s toolbox.

Around the turn of the millennium, it was then suggested that 3D-printed parts could also be used directly as end-use products, eliminating the need for traditional production processes such as moulding, casting and machining. Over the following decade, a small number of highly specialised and high-value products were developed using 3D printing as a production process, including hearing aids, dental and orthopaedic implants and complex, but small, high-value aerospace components.

3D printing promises manufacturing companies the opportunity to make low-volume, individualised products, with almost unlimited complexity. It offers manufacturers a production solution where their customers can engage in the design process, locking customers into a world of mass product personalisation. It also offers new levels of environmental and economic sustainability, where parts are made to order using highly efficient supply chains with no stock holding and no waste.

What’s more, put into the hands of consumers, 3D printing machines at home could change the way products are retailed forever, with the digital downloading of 3D printing data files replacing home deliveries. In short, 3D printing appears to be the type of technology that could stimulate both an industrial and a consumer revolution.

So why, after almost 30 years, are we still waiting for either a silent industrial or very public consumer revolution in manufacturing to happen?

3D printing technologies have significant technological limitations. Compared to established manufacturing processes they are woefully slow to make products, with their productivity measured in grams of material printed per hour, compared to processes such as injection moulding, measured in hundreds of kilograms per hour. 3D printing materials are also expensive compared to those used in established processes, often costing ten, 20 or even 100 times more per kilogram.

Moreover, industrial 3D printing technologies can be costly, ranging from tens of thousands to hundreds of thousands of euros. This limited productivity coupled with high material and high machine cost results in parts which are orders of magnitude more expensive than parts produced with established technologies.

These economic barriers limit 3D printing to just a handful of high-value, low-volume applications where the economics can make sense. But, for many such applications, for instance medical or aerospace parts, there are also technological considerations which limit the uptake of 3D printing. Because 3D-printed parts are produced layer-by-layer, they exhibit different mechanical properties to conventional materials making them difficult to test, validate and approve. 3D printing is also hampered by a limited pallet of available materials, along with part accuracy, repeatability and overall quality.

As time progresses, the cost of 3D printing machines and materials will undoubtedly decrease as the technology penetrates more sectors and finds new applications. The technologies used in 3D printing will also improve in terms of their productivity, accuracy and repeatability, and material properties will fall in line with more established processes. But this won’t happen overnight.

Significant levels of investment in research and development will be needed, covering a range of disciplines from material science and engineering, through to software development and machine design. All this will take time, effort and resources.

Luckily, the EU is very well placed to lead this future development, given that many of the leading technology, material and software companies are located here, along with some of the strongest university research groups. What we need now is coordinated action across the EU, to ensure future developments in 3D printing

have both a local and global chance of exploitation.

More info

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