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3D printing: the dawn of agile R&D

Part of our 30th anniversary series, Sagentia takes a look at some of the key trends in the last three decades and how these breakthroughs in science and technology have impacted the way we live and work today.

A Sagentia
white paper

3D printing: the dawn of agile R&D

The third in our series, this article takes a look at the evolution of 3D printing, its role in accelerating product development and bringing new products to market. The article explores what difference the technology has already made to development processes in industrial, medical and consumer markets and goes on to look at the potential for bridging the gap to rapid *production.*

From mould to manufacture

3D printing makes it possible to produce complex objects directly from three dimensional digital models. Instead of forming a component or prototype by cutting away a solid block of material (such as in subtractive techniques like machining), 3D printing works by stacking two dimensional cross sections in successive layers to build the final object. This process gives 3D printing its other name – that of additive manufacturing.

3D printing first became part of the product development process when the first devices became available, three decades ago. It was used to rapidly build in resin and later, in the late 1990s, using polymers and metal alloys. The arrival of 3D printing coincided with the interest shown in Japanese manufacturing techniques which helped to bring new innovations to market quicker through 'lean' and 'Just in Time' techniques. At the time, 3D printed prototypes had limited value due to their poor accuracy and low strength which limited them to non-functional testing.

More recently rapid prototyping techniques have been used to create shapes that would be virtually impossible, at reasonable cost, to produce using standard subtractive techniques. For example the complex fuel injection parts that aerospace companies create and incorporate as products.

Three decades later, final moulds, end use parts and components, as well as finished products, can be 3D printed in hundreds of materials. A range of technologies and materials are widely used today.

Fail-fast, rapid development

Whilst the *speed* of prototyping has been the key advantage to date, increasingly prototypes need to show characteristics close to the finished product. As materials and tolerances get closer to the final specification, more comprehensive testing is possible. Fail-fast iterative cycles are now possible but challenge some of the long-held beliefs of best practice product development.

Alistair Fleming, VP medical at Sagentia comments: “We’re still quite stuck in the tradition of A model then B model. As the gap closes between rapid prototype and rapid production the idea that you get one go at a non-representative model first, then do it ‘properly’ starts looking a bit old school. Technology is shifting the model away from high capex mould tooling as a disincentive to product redesign. Perhaps the line starts to blur between development and released product much like software is forever iterating in-market”.

It’s long been said that the Silicon Valley mantra of ‘fail-fast, fail often’ is one of the reasons why US companies dominate lists of the world’s most innovative companies. Rapid prototyping’s ability to make it less costly to fail may help to bridge that divide.

Alun James, CTO, Sagentia Commercial explains ‘when Sagentia is developing new products for fluid handling, such as flow meters or dispensing & mixing systems, the necessary CFD modelling is intensive and very dependent on accurate input conditions. This is particularly important when the fluidics are moving across a range of flow conditions, for example, in the transitions from laminar to turbulent flow. The ability to quickly 3D print a flow tube and immediately run some experiments to validate the theoretical models has allowed significant shortening of the design process. It’s now possible to have rapid prototypes that are strong enough to withstand the fluid pressures and smooth enough to be representative of a final moulded part’.

Industrial markets

International Data Corporation’s (IDC) latest forecast states that worldwide spending on 3D printing is expected to surpass $35 billion in 2020. This will be largely driven by industrial and business applications focused on reducing manufacturing cycle times and prototyping costs. The use cases that will generate the largest revenues for 3D printing this year will be rapid prototype design in Automotive and Aerospace as well as Dental markets.

GE has more than 400 3D printing machines currently in use across its business and the company says that GE Aviation will manufacture more than 100,000 additive parts by 2020. The company is embracing 3D printing for accelerating production and has even given its engineering approach a motto of ‘Think Additively’.

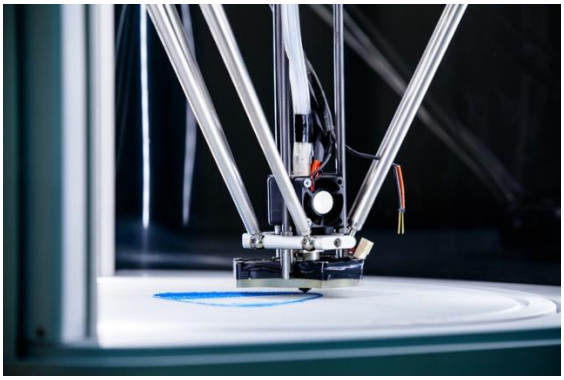
The Airbus A350 XWB aircraft contains over 1,000 3D printed parts. As a testbed for futuristic aircraft technologies, Airbus has unveiled a small-sized pilotless aircraft called Thor, which it made using 3D printing. It seems Airbus are adopting the approach of sweeping the aircraft off the runway and printing a new one, if the aircraft crashes, as a result of any test prototype failure.

Volvo announced in 2015 that it uses 3D printers to produce critical production line tools in 2 days rather than 36.

Consumer markets

Rapid prototyping is not just about speeding products to market. It can also be about customised manufacturing in small volumes, perhaps, as batches of one. It can therefore be a game changer, providing new opportunities for competitive differentiation.

Iain Ansell, Managing Director of Sagentia expands: ‘In the consumer world, rapid prototyping means personalisation and the possibility of production runs of one. OwnPhones is one such company providing wireless, custom-fit, 3D printed ear phones but the opportunities exist anywhere a bespoke fit is needed or preferred from glasses to apparel.



3D printing enables mass personalisation. It makes it cost-effective and technically possible to customise in large quantities or run production lines in batches of one and brings the consumer deeper into the design process.

Medical and dental

Victims of serious facial injuries are now benefitting from 3D printed titanium implants precisely customised and with the ability to mimic the properties of bone. Such a technique was recently demonstrated by surgical experts at the Universiti Kebangsaan in Malaysia.

Nicholas Collier, CTO Sagentia Medical expands: ‘3D printing of autologous cells to form implantable structures will mature. The manufacture of sound holograms using 3D printers means that complex sound fields could be generated from a single ultrasonic transducer. Low-cost 3D printing of the

diffractive acoustic element to match the scan could create customised sound fields for individual patients under-going ultrasonic therapy and personalised treatment'.

In the mid-eighties, Sagentia worked on the rapid production of hearing aids. These are now commonly 3D printed using a scanned impression of the ear as the input to the 3D model. The use of 3D data takes the pressure off the production process itself but relies on accurately capturing the detail within the 3D model.

The 3D printing of new biocompatible materials such as biodegradable polymers and ceramics which can be used as substitutes for bone are all emerging as are the 3D printing of food and high strength-low weight composite materials in industry.

In dentistry traditional subtractive approaches can struggle with the precision fits required and there are also huge amounts of wastage involved with subtracting materials from an initial block or material to create the desired shape. So 3D printing and digital dentistry provide the opportunity to create custom-fit orthodontic applications and prosthodontics, cost-effectively.

Fearless Innovation

The most exotically located 3D printer must be that at the International space station. Its job is to make mission-critical replacement parts to make the station less reliant on supply missions.

Closer to home, new applications in both manufacturing and medical markets will continue to emerge. On-demand human organs may become a real possibility as, what are currently, experimental bioprinters mature.

3D printing will continue to be a pivotal technology which will be increasingly embedded in product development processes across most industries. Its significant ability to free up innovation from the shackles of protracted and expensive development cycles is only just becoming known.

Sources

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About Sagentia

Sagentia is a global science, product and technology development company. Our mission is to help companies maximise the value of their investments in R&D. We partner with clients in the consumer, industrial, medical and oil & gas sectors to help them understand the technology and market landscape, decide their future strategy, solve the complex science and technology challenges and deliver commercially successful products.

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