



TECHNOLOGY - MAKING IT QUICKLY IN METAL.

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Andrew Baxter on a breakthrough in rapid prototyping.

On the table in front of Richard Fedchenko is a small propeller blade made of cured polymer. It is a typical product of rapid prototyping - the process that manufacturers have been using for the past five years to help speed up their product development.

Next to it is the same blade cast in metal. It might normally have taken months to produce, but is also a product of rapid prototyping.

Fedchenko is a senior executive at 3D Systems, the California-based company which dominates the rapid prototyping industry. Last month, 3D launched QuickCast, a new rapid prototyping and tooling technology that claims to reduce the lead time on metal castings by 80%.

The launch is a big event for 3D and 'a quantum leap' for rapid prototyping, says Fedchenko. As such, it could have important business implications for rapid prototyping as a contributor to concurrent engineering, the umbrella term for using teamwork and technology to get products onto the market quicker and to increase competitiveness.

Rapid prototyping is already being used by hundreds of companies worldwide, including British Aerospace and Mercedes-Benz. It takes any three-dimensional computer-aided design (Cad) file of a part, converts it into hundreds of layers and builds the prototype from that.

3D uses a system that traces each layer by directing a laser-generated ultraviolet light on to the surface of a vat of liquid polymer resin.

Rival companies have different solutions such as 'instant slice curing' from the Israeli-US supplier Cubital, and laminated object manufacturing from Helisys in California. Several other companies, mainly US, are working on their own approaches.

The process has already proved its worth, says Fedchenko. Weeks have been saved producing prototypes that can be discussed, looked at and handled by the product development team. The prototype can also be used as a strategic marketing tool. Logitech, the computer mouse producer, used rapid prototyping to produce a mouse in 10 days for a meeting with IBM, he says.

But, while manufacturing industry has shown a lot of interest in rapid prototyping, some potential users have been waiting until it is possible to produce a metal part by rapid prototyping. Once a cast metal part is produced, it can be subjected to stress analysis, wind tunnel testing and other tests necessary before production - none of which can be carried out on a polymer prototype.

This has become something of a holy grail for the rapid prototyping industry, because the current method of casting a metal prototype can take several months. It involves machining hard tooling from metal to produce wax patterns, which can then be cast using the traditional 'lost wax' process.

Unfortunately this investment casting process - 'investing' the pattern in a slurry, heating to produce a ceramic mould and burn off the wax, then pouring molten metal into the mould - does not work with 3D's normal polymer prototypes. They expand with the heat, cracking the mould.

Fedchenko says 3D has now solved the problem. Its QuickCast process produces a part with a complex internal triangular gridwork, which allows the part to collapse into itself during heating, leaving the mould undamaged.

The gridwork reduces the weight of the prototype by two-thirds, leaving a much smaller residue of ash which can be sucked out of the mould with compressed air. A new type of epoxy resin, developed by 3D and Ciba-Geigy, has replaced the acrylate resin used previously. This has increased accuracy by 100%, says Fedchenko, and produced a much smoother finish that does not need to be sanded and polished.

The result is a very accurate metal prototype which can be produced some three to four weeks after a Cad design is completed, compared with an average of 18-20 weeks using wax patterns.

On more complicated parts, significant sums of money can be saved as well as time.

At last month's World Conference on Investment Casting in London, 3D was exhibiting an aero-engine front frame prototype made by a division of Allied-Signal, which saved \$100,000 (£67,000) and 44 weeks using QuickCast. Other rapid prototyping companies are working on producing metal parts, but 3D's advantage is its installed base of some 350 prototyping machines worldwide. The fastest 3D machines with the biggest vats could cost as much as \$400,000 in the UK, and 3D is offering QuickCast as an \$8,000 software add-on, excluding the cost of the new resin.

But, says Fedchenko, rapid payback is not in itself a sufficient justification for investing in rapid prototyping. 'You have to have a compelling need. The message is: does it give you a competitive advantage by getting you to market quicker?'

Fedchenko believes the world rapid prototyping market could double over the next two years from \$45m- \$50m because of QuickCast. 3D is targeting foundries, traditional tool and die shops and rapid prototyping service bureaux and manufacturing industry from aerospace to medical implant producers.

And the next stage? 3D is working on adapting its technology to produce the dies used in injection moulding machines. Further development is required, says Fedchenko, but 'rapid manufacturing' is on the horizon.

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