

3D opens up the desktop market

Cost had always restricted take-up of 3D print technology, but suppliers are now cutting prices dramatically to develop the lower end of the market. *Steven Kiernan* examines its prospects

The next time you need, say, a new mobile phone cover, how useful would it be to get it on-demand in a few minutes without leaving the comfort of your own home? It all sounds a bit sci-fi, but you'd better make room beside your laser printer, because 3D printing is here and it has designs on your desktop. After more than a decade in high-end industry, 3D printing is mounting a charge on the mainstream.

The process, also known as rapid prototyping, does exactly what it says on the tin; rapidly creating real-world models from 3D data. Machines across the globe churn out prototype shoes, engineering models, toy designs and architectural maquettes – the possibilities are endless.

Two decades ago, 'additive-fabrication technology' was limited to hulking, expensive and complicated systems. A revolution came in the early '90s when manufacturers, such as US-based Z Corporation repurposed fledgling inkjet printhead technology to create smaller, less expensive units.

Since then, prices have continued to fall and opportunities for new markets are opening up. Manufacturers, customers and pundits alike forecast a day in the very near future when 3D printing will be affordable not only for small design houses, individual architects and schools, but home users too.

It's easy to compare this trend to digital print, but where printhead technology rocked the home and office sectors before setting its sights on high-output commercial work, 3D printing was an industrial process that is only now moving into the lower end – the inkjet revolution in reverse.

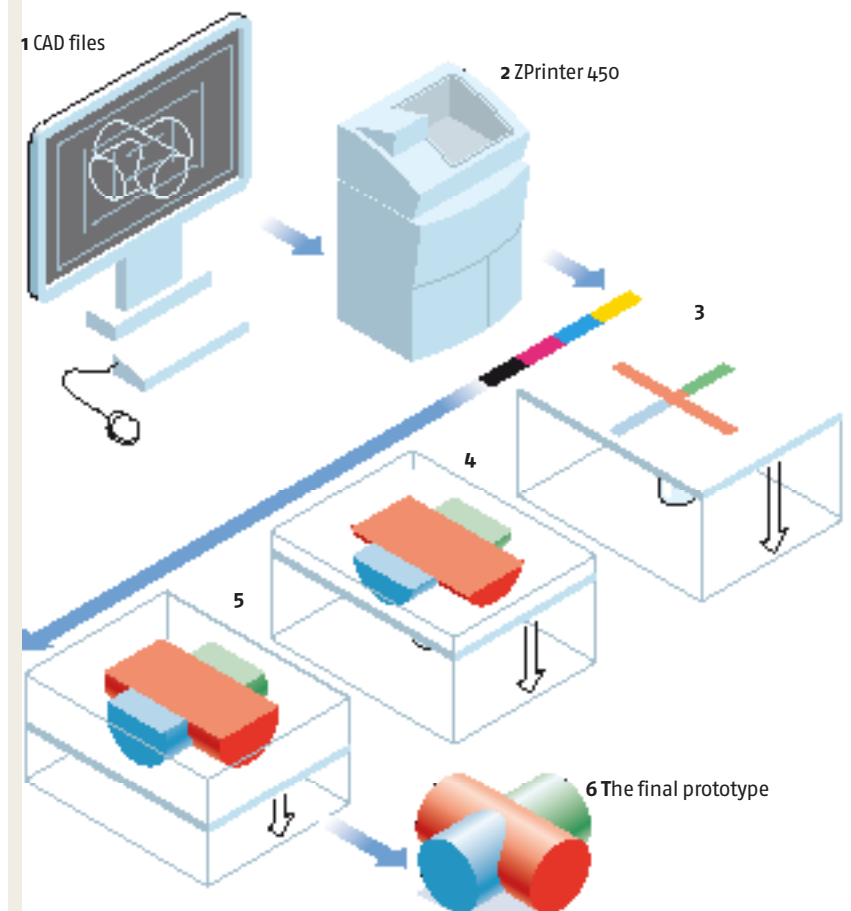
The problem of price

Price has always limited 3D printing's entry into new markets, but not any more; a US-based technology start-up has turned its attentions to the office environment with the lowest-priced kit yet. Desktop Factory, established in 2004, was formed "to make affordable desktop 3D printing a reality". Chief executive Cathy Lewis explains: "We believe that, as the prices drop, the consumer market will embrace 3D printing. It may never be as ubiquitous as 2D printing, but the home market will be an important one."

Desktop Factory is now taking orders for its monochrome 125ci machine, "priced disruptively lower than the nearest competitive offering" at £2,440 (\$4,995), a quarter of the price of leading black-and-white rivals. The 18-staff firm also plans to undercut the typical replicating cost of £1.20-£3.80 per cubic inch – the 125ci builds equivalent models for 50p.

Lewis believes price is key to capturing the untapped lower-end market, and has the ambitious aim of releasing →

HOW IT WORKS ZPRINTER 450



The process begins with industry-standard digital CAD files (1). 3D data is imported into software that slices the file into cross-sections. These are fed into the 3D printer (2). Rollers apply a layer of powdered base material onto a tray in the machine. This layer is then coated with a binding solution from repurposed inkjet printheads that solidifies into an exact replica of the cross-section (3, 4, 5). A colour model such as the 450 uses a typical four-colour printhead to deposit a pigmented binder. The tray is lowered to make room for the next layer, and the process continues until the prototype is complete (6).

3D AT HOME FABBERS

A £10,000 price tag is far too high for some rapid prototyping enthusiasts. The worldwide 'Faber' movement has sought to develop 3D printers for the average punter. The campaign, with its high ideals and widespread online communities, is not limited to groups of *Star Trek*-fixated home hobbyists tinkering in their garages. Websites, such as the one pictured right, offer a wealth of information, both practical and academic, where instructions on building your own printer are sometimes laced with political ideology. In some respects, these grassroots projects form a counterpoint to 3D printing as a commercial enterprise.



The Fab@Home project touts itself as "democratising innovation" and aims to put the technology into the hands of "curious, inventive, and entrepreneurial citizens". The Bath Replicating Rapid Prototyper Project, or 'RepRap', operating from Bath University, goes further to envisage desktop self-replication, where rapid prototyping machines spawn clones of themselves. Senior lecturer Adrian Bowyer, who is the driving force behind RepRap, upholds the movement's ideological roots, dubbing the RepRap process "Darwinian Marxism", which could provide future generations with "wealth without money".

kit for under £500 within five years. But the young firm faces stiff competition from the sector's power players. Z Corporation has been in the 3D print business since 1994, and has had significant input into crafting and maturing the technology. It has hundreds of staff, thousands of customers and a global reach, with a strong UK client base that spans the core fields of product design and engineering, as well as a firm foothold in the growing education market.

Z Corporation UK sales manager Alan Spence says the technology's growth area is affordable colour kit and stresses the importance of automation. "We want our machines to be so easy and so economical that anyone can use them," he says. The uptake in colour kit, thanks largely to the flagship £25,000 ZPrinter 450, means the UK colour market has gone from 20% three to four years ago, to 70% today. The type of customer is also changing. "We used to only make kit for the semi-workshop environment, but now people can print in-house, instead of outsourcing prototyping to 3D service bureaux," says Spence.

John Kawola, executive vice-president of sales, marketing and business development at Z Corporation, adds: "In the past, rapid prototyping could only be used by the biggest companies. The biggest trend is that, over three to four years, it's moved away from being highly specialised and is now available to smaller companies because of the price point."

Embracing inkjet

Z Corporation bypassed heavy R&D costs by embracing inkjet technology (see box, previous page). "We use exactly the same heads as inkjet – HP printheads," says Spence. "You could buy one from your local office superstore. HP produces billions, which keeps costs low and makes our prices low."

Kawola seconds this: "Our strategy has always been to leverage R&D of inkjet manufacturers in terms of colour, cost and speed. This keeps our R&D costs down – HP pays for it."

The dual strategy of improving technology and cutting prices is a winning formula. Kawola adds: "The technology we sell for £10,000 now is better than the technology we sold for £30,000 a few years ago."

Desktop Factory has sought to lower costs even further and make its product yet more accessible by breaking the ties with inkjet. "Our technology does not rely on inkjet heads," says Lewis. "We didn't want to cross-license technology if possible and we were loath to introduce caustic chemicals." Cutting the health risks also helps open up the home market.

The process already has an avid following outside the commercial arena. The 'Faber' movement comprises hobbyists piecing together 3D printers in garages for their own use at rock-bottom prices. Some seek to build their very

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**Alan Spence,
Z Corporation**

own *Star Trek*-style 'replicator'. Others hold up 3D printing as the route to widespread political change with its promise of consumer goods without the cost (see box, above). But while these enthusiasts have paved the way for the notion of 3D printing as a home-user technology, for the process to truly succeed at the lower end of the market, potential customers must extend beyond fans with a passion for science fiction and a penchant for political posturing.

According to Wohlers Associates, the leading US analyst of 3D print, there is a large potential market for affordable systems. President Terry Wohlers says machines selling for less than £10,000 accounted for 73% of the market in 2006, a figure set to increase as more companies jump on the affordability bandwagon. But he questions the sense of Desktop Factory dropping its prices so low. "At £2,500, you'd need to sell a boat-load of systems to make it economically feasible," he says. "Can a company such as Desktop Factory make it up in volume? It's much too early to predict."

Focus on the individual

But Z Corporation's Kawola sees individual consumers as an unexplored seam. "We definitely think there will be a large market in the future for individuals to get a 3D part." While he stops short of targeting the home as a market for 3D machines, Kawola reckons the demand for "unique" and "customised" 3D models will be a massive boost to sales.

He compares this to the upheaval in digital photo printing. A few years ago, "printer manufacturers convinced me to buy a desktop photo printer", he says, adding that the machine now gathers dust as he, like so many others, opts to order online or on the high street. 3D printing can learn from this model, as there is increasing demand from individual users who want a part, backed up by the wealth of 3D data filling hard drives and spanning the internet.

Desktop Factory's Lewis agrees. "The real end of the rainbow is the creative disruption of the manufacturing value chain," he says. "Instead of driving to the hardware store to get a replacement part, you will go to a manufacturer's website and pay a small fee to download that object."

Kawola uses the games industry as an example. "Video games are huge and these days, you can fully customise your in-game characters." Z Corporation is working with game developers to create a service whereby gamers can "press a button and get a model of their avatar in the mail – 3D printing is the only economical way of doing this".

The future for the sector looks bright, as 3D printing leaves the engineering and aerospace firms and seeks out the high street and the classroom. It might even be time to clear away the clutter beside your humble home printer. ■

