

# hands on

## 3-D PRINTERS PROLIFERATE

But desktop manufacturing isn't yet ready for your desk

FOR YEARS, visionary engineers have been touting the idea of a cheap box about the size of a microwave oven that could build arbitrary solid objects out of plastic, ceramics, metal, ice, and even living cells.

During most of the 20-plus-year history of 3-D printing, "cheap" has been a distant vision, with industrial rapid-prototyping machines going for anywhere from US \$15 000 to over \$1 000 000. That number started to drop precipitously in 2007, with 3-D-printer designs from RepRap and Fab@Home that could be built for \$500 to \$2000 in materials (depending on what materials you wanted to print and how good you were at scrounging parts). This spring, 2-D printer giant Hewlett-Packard jumped on the moderate-price bandwagon, announcing it would introduce HP-branded 3-D printers (actually built by Stratasys) in Europe for €13 500, or about \$17 500.

If the price of a new compact car is more than you or your boss would like to spend, New York City start-up Makerbot Industries offers a small RepRap-derived printer kit for about \$900. British RepRap parts supplier Bits From Bytes sells parts for a rather larger, reportedly more reliable unit for £750 (about \$1200) and offers fully assembled machines for \$3000 and up.

But what are these machines actually good for? PR representatives for HP and Stratasys make it clear that their new machines are for mechanical engineers and designers to make mock-ups and prototypes of new ideas (and for educators teaching the next generation, who will likely work in a world where 3-D fabrication is commonplace), but not for consumers: Despite HP's reputation for building high-end consumer

printers, this is not one of them.

And although the fully assembled machines have established a strong reputation for reliability, do-it-yourselfers must beware the 3-D equivalent of the paper jam, which often involves scattered blobs of solidified plastic, smoking circuit boards, or half-melted motor mounting brackets. Internet forums and builder blogs are full of stories about hours spent rebuilding extruders, days tweaking the alignment of build platforms, and nights rewriting the software that "slices" designs into layers that can be built up on top of one another without drooping or warping or overtaxing



**PART SOLUTION:** Make small plastic parts on your own with a 3-D printer, such as HP's [above right]. PHOTOS: HEWLETT-PACKARD

a printer's tiny CPU. There is even a cottage industry of higher-strength spare parts for the kit components that are most likely to fail. If atoms are indeed the new bits, as the futurati have declared, then consider what the world will be like when mechanical objects are as buggy as the typical piece of software.

Indeed, at the hacker level, the most popular print runs seem to be 3-D printer parts. If you want something built for use, you might have better luck shipping your design to one of the rapid-fabrication services that have sprung up all over the world.

But Ian Adkins, technical director of Bits From Bytes, views things a little



differently: Engineers, hackers, and educators have purchased thousands of the company's kits—initial production of the new fully assembled model is fully spoken for—and he is happy to report that at least some of his customers are building actual products as well as prototypes and models. If your annual production of any particular plastic bit is only a few hundred pieces, he says, the cost of a 3-D printer can be a fraction of the setup costs for machining or injection molding.

And if tinkering is part of the attraction, you'll join thousands of other hackers who are getting the design of extruders, construction platforms, structural frames, controller boards, and other parts just right. Yours could be the innovation that makes cheap fabrication a turnkey process for the rest of us.

—PAUL WALLICH

### 3-D printers, kits, and parts

<http://www.bitsfrombytes.com>

<http://www.makerbot.com>

<http://www.makergear.com>

### Manufacturers of 3-D printing equipment

<http://www.stratasys.com>

<http://www.zcorp.com>

<http://www.objjet.com>

<http://www.3dsystems.com>

### Fab services

<http://www.shapeways.com>

<http://www.redeyeondemand.com>

### Open-source design repository

<http://www.thingiverse.com>

### Ongoing development

<http://www.fabathome.org>

<http://www.reprap.org>