Desktop manufacturing

Fabulous fabrications

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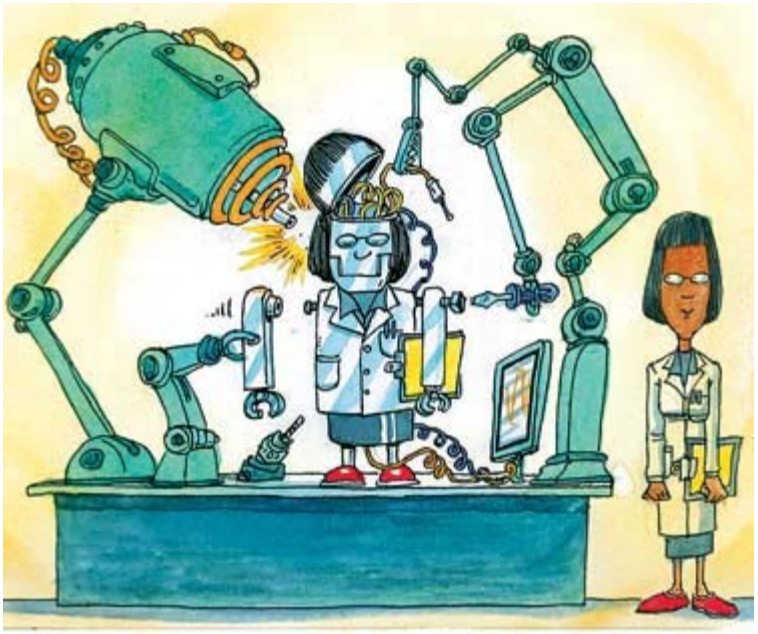

A way to help inventors in poor countries realise their ideas

STAR TREK had the replicator—a device that could assemble any object, atom by atom. The Nutri-Matic vending machine concocted drinks molecule by molecule in "The Hitchhiker's Guide to the Galaxy", personalising them by analysing an individual's taste buds, metabolism and brainwaves (though then, it has to be admitted, turning out a beverage that tasted almost, but not quite entirely, unlike tea). Now, for those still stuck on Earth, Neil Gershenfeld, the director of the Massachusetts Institute of Technology's Centre for Bits and Atoms, has built version 1.0 of the personal fabricator, and it is already being deployed around the world.

The "fab lab", as Dr Gershenfeld has nicknamed his invention, is a collection of commercially available machines that, while not yet able to put things together from their component atoms, can, according to its inventor, be used to make just about anything with features bigger than those of a computer chip. Among other tools it includes a laser cutter that makes two-dimensional

and three-dimensional structures, a device that uses a computer-controlled knife to carve antennas and flexible electrical connections, a miniature milling machine that manoeuvres a cutting tool in three dimensions to make circuit boards and other precision parts, a set of software for programming cheap computer chips known as microcontrollers, and a jigsaw (a narrow-bladed cutting device, not a picture puzzle). Together, these can machine objects with a precision of a millionth of a metre. The fab lab's purpose is to endow inventors—particularly those in poor countries who lack a formal education and the resources to implement their ideas—with a set of tools that can translate back-of-the-envelope designs into working prototypes.

And it works. In Pabal, an Indian village with a population of 5,000, a dairy farmer's income is tied to the fat content of his cow's milk. Students at the nearby Vigyan Ashram science school are using a fab lab to build a sensor that will give Pabal's farmers a precise measure of that fat content. In Takoradi, Ghana, people have used the labs to produce a cassava grinder, jewellery, car parts, agricultural tools and communication equipment such as radio antennas. Solar-powered items to harness the relentless local sunlight are in the works. In Norway, Sami animal herders—who are among Europe's last nomads—are using fab labs to make radio collars and wireless networks to track their charges. And in Boston (admittedly not part of the developing world, but conveniently near MIT), the residents of a mixed-income housing complex are using one of Dr Gershenfeld's labs to create a wireless communication network.

Thunderbirds are go

The idea for the fab lab sprang from a popular MIT course titled "How To Make (Almost) Anything", which provides a hands-on introduction to multimillion-dollar machines such as supersonic waterjets, powerful lasers and microscopic atom beams. In addition to engineering regulars, the class attracts scores of artists and architects who use the technology as a means of personal expression. These outsiders have designed a web browser for parrots, an alarm clock that has to be wrestled off just to make sure you really are awake and other such useful items.

But it was not so much the utility of the artists' inventions that Dr Gershenfeld noticed, as the fact that they were built by people with original ideas but a negligible background in technology. He realised that if he could put together an affordable, portable, tabletop version of the course, that concept could be taken to the masses. He identified the essential hardware and software, wrote a special program to translate designs into machine instructions, and then packaged the whole lot together.

Dr Gershenfeld believes the world is poised for a personal-fabrication revolution. Fab lab will, he hopes, be part of it. Just as computing power moved from million-dollar mainframes to hundred-dollar PCs, industrial-scale machinery is, in his opinion, beginning a transition to the desktop. While personal fabricators will not replace mass production, he believes that within the next few years they will allow individuals and small businesses to customise products to their needs. At $20,000 each—not a trivial amount of money in a poor country, but not outrageous either—the fab lab may indeed release an outpouring of frustrated talent.

There does, nevertheless, remain the question of who will pay. The World Bank and the other usual sources of finance for international development say they appreciate fab lab's potential, but consider the project far too speculative. They prefer investing in proven technologies rather than in the process of technology development. Despite this, the labs may be able to spread without support from traditional aid agencies because they may be able to become economically self-sustaining quite quickly. When word of the lab in Takoradi spread, for example, people came from far and wide to use it. Relatively small amounts of venture capital—possibly provided by so-called microfinancing, which pools savings in poor countries to make tiny investments or loans to local enterprises—could help get fab labs off the ground. If that happens, says Dr Gershenfeld, a fab lab

can probably be used to fabricate new versions of itself to keep up with the demand.