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# Digital manufacturing – Napster fabbing: Internet delivery of physical products

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*Marshall Burns and James Howison*

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## The authors

**Marshall Burns** is President of the Ennex Corporation, Los Angeles, CA.

**James Howison** is an expert on the political economy of the Internet. He is currently preparing to pursue a PhD in the politics and economics of the information economy.

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## Abstract

Looks at “fabbing” – digital fabricating of physical products and its future in the business world via the Internet. Concludes that this is a process that is here to stay and therefore technology needs to become more sophisticated to accommodate it.

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The sharing of music and movie files in peer-to-peer exchanges on the Internet has opened a Pandora’s box of controversy on how to control and profit from creative properties in the digital era. Yet music and movies are only the tip of the iceberg in the world of valuable intellectual property. Technologies currently under development and in limited commercial use present the future possibility of distributing physical products on the Internet by downloading and manufacturing directly in customers’ homes and offices or in local facilities (sort of a “3D Kinkos”).

Digital manufacturing is performed by a family of modern technologies that capture, transmit, and manifest 3D digital descriptions of physical products. The central technology is the digital fabricator or *fabber*, also called a 3D printer because it produces 3D digital output in solid material. Invented for use by engineers for rapid prototyping of all manner of products from automobiles to zippers, fabbers are now also used by physicians and scientists, Hollywood prop makers, digital sculptors, and even pornographers.

As fabbers improve in user friendliness and decline in price, their proliferation among professional and recreational computer users will provide a whole new purpose for peer-to-peer exchanges like Napster, Gnutella, and FreeNet. With fabbers instead of MP3 players and \*.FAB files instead of \*.MP3, the inventories distributed by such networks naturally expand from information products to the real and physical: toys, clothing, furniture, sports equipment, consumer electronics, and even, one day, automobiles. Digital fabbing will be to designers, engineers, and manufacturers what MP3 has been to musicians and record companies.

A television commercial for United Parcel Service, first aired in 1999, showed four scenarios of people ordering products online and taking delivery in their homes and offices via a digital fabber hooked up to their computers. In the commercial, these fabbers completed the delivery of a pair of scuba fins, a trombone, a water bottle with water in it, and a genuine leather football. Is this possible? Will

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people one day be able to go online and order whatever they want and have it just show up?

### What is fabbing?

Since the dawn of history, products have been made by three basic processes:

- (1) You start with a solid block of material and carve away the stuff you do not want.
- (2) You stick together a bunch of pieces of the material you want.
- (3) You take a pliable material and push on opposite sides of it to give it the shape you want without either adding or removing material.

Fabbers work by the same basic processes. The difference is that they automate those processes, taking their instructions from a digital file that describes the desired shape and structure. Fabbers combine digital data with physical material to make products. Fabbers today are limited to making simple products in simple materials, but in the not-too-distant future, fabbers will be able to make almost any product you can imagine (and maybe some you cannot imagine)!

Digital fabbers create a whole new paradigm for manufacturing, which is an iteration cycle that starts with a digital representation for a product. The data can come from a designer using CAD or from scanning an existing product. The data are transformed into physical material by a fabber. Fabbers can be connected to data anywhere in the world by the Internet. In the future, nanorecyclers will consume previously fabbed products to provide fresh raw material for fabbing new products.

Fabbers today are used primarily for rapid prototyping, making models of new product designs for manufacturing engineers and manufacturing designers. They are also used by medical doctors for surgical planning models or custom-fitting prostheses, as well as by architects, Hollywood prop makers, and a new breed of "digital sculptors."

In the future, fabbers will reach the nearly magical capabilities shown in the UPS commercial. We are still decades away from several of the capabilities shown there, but they are under development in hundreds of university, corporate, and government laboratories around the world. Today's fabbers work at the *milliscale*. On the horizon

are the next generation, *microfabbers*. Around the middle of the century we can expect to see the ultimate capabilities in the form of *nanofabbers*.

We are starting to see companies tie the magical capabilities of fabbers to the Internet. ToyBuilders.com uses fabbers to make toys from customers' own designs. MyB2O ([www.myb2o.com](http://www.myb2o.com)) is a partnership of fabber manufacturer 3D Systems and several software companies to offer custom manufacturing services via the Web. ProtoMarket.com is a B2B exchange, connecting fabber operators with designers needing models made. InPart Solutions ([www.inpart.com](http://www.inpart.com)) is one of several companies that offer libraries of 3D data suitable for making fabable designs. And ProtoShape ([www.protoshape.com](http://www.protoshape.com)) is the Web site of a San Francisco-area sculptor who has embraced fabbers in the production of her astounding mathematical creations.

### The Napsterization of manufacturing

There is a community of fabber users on the Internet, called the *Rapid Prototyping Mailing List* (the RP-ML). Over the years, members of the RP-ML have occasionally engaged in trading or exchanging 3D design files for use in fabbers. Requests for models have included a set of human teeth, a horse, and the Indian gods Hanuman and Ganesh. Sometimes members also offer each other free design files, such as a pair of Valentine's Day hearts provided as StL files.

One RP-ML member requested a Roman building to help his daughter with a school project. This was answered the next day by another member who had built a Roman temple for his daughter's school project the year before. He posted the file on his FTP site for all to enjoy. This is *Napster fabbing*, people freely sharing 3D digital designs, peer-to-peer, online! It may not yet be as automated as the musical Napster and other P2P file-sharing facilities, but it is serving exactly the same purpose for 3D product designs as Napster serves for music!

To think about the impact that this kind of file-sharing could have on the manufacturing industries, one need only look at the music industry. The free exchange of MP3 files directly impacts the music industry's distribution chain. The elimination of the

physical record or CD as a revenue control point potentially cuts the recording company out of the loop and makes valuable musical works freely available. This is frightening for those companies, as well as for many artists, who have relied on the record labels for their income.

We can have an analogous situation in manufacturing. Fabbers, capable of flexible production in homes and small studios, can link directly to designers through digital files or a live hook up. This cuts out the companies we think of today as manufacturers. Like the record labels, manufacturers have made their money by controlling the distribution of the physical manifestations of creative designs. Just as Napster brings the musician out from behind the record label, fabbers on the Internet bring product designers out from behind the manufacturer and leave them facing the users of their designs directly. This leaves the quandary for designers of how to get paid for their work.

As in other cases where revenues are in doubt, designers and manufacturers will have to ask themselves (as musicians and recording companies should be asking themselves today) what business they are in. In other words, what is it that people will pay them for? What is their value proposition? It will become increasingly difficult to get paid for the physical arrangement of atoms in a product because that will be too easy for fabbers to make. Even the creative content – the intellectual property – of a design fades in monetary value because it is too easily duplicated. The value that is left for product designers (as for musicians today) to capitalize on is their relationships with their “audiences.”

The problem for recording companies today is that they are locked into a mindset in which they develop revenues from controlling intellectual property that is becoming impossible to control. In a future of widespread Napster fabbing, manufacturers and product designers could face a similar dilemma. But controlling intellectual property is not the only way to get paid for making music, and controlling distribution of physical objects is not the only way to get paid for designing products. Throughout history, we have seen many alternative business models for the support of creative production, such as

commissioning of works and patronage (of which the twentieth-century forms of corporate and government grants may evolve into the twenty-first-century form of distributed patronage), tipping of the busker (which is now showing up in forms like FairTunes ([/www.fairtunes.com](http://www.fairtunes.com)) and Amazon.com’s Honor System), the performance ransom (by which the legendary Aesop spun stories in exchange for daily commutation of his death sentence, and updated today in the form of the street performer’s protocol), even “waitering,” in which the creative person is so committed to the work that he or she supports it personally with income from a “day job” (also represented today in the open software movement).

### Business models

During the California gold rush, so many people were digging in the ground looking for gold that it sometimes seemed that the only people making any money were those selling shovels. People will always be designing new products for other people to make and use, no matter how it turns out they get paid for it. There are numerous business models for a fabber company. It can profit from the direct sale of fabbers (until development takes us to nanofabbers that will be able to reproduce themselves), possibly from distribution of design data if the copyright forces prevail, from partnering with its customers in offering fabbing services (customers being like neighborhood 3D Kinko’s), and from distribution of specialty materials for use in its fabbers.

The market today demands instant gratification. In response, the peer-to-peer Internet plus audio speakers and video screens are changing the way people get their music and other information products. In the future, the peer-to-peer Internet plus fabbers and 3D scanners will change the way people get real, physical products. The RP-ML is already demonstrating that people can and will exchange design data for fabbing. *Napster fabbing* is here today. All that is left is for the technology to grow in sophistication and usage.