

# The Future Is Now: Why 3D Printing Can Make the World a Better Place

## The new technology will transform modern industry. It shouldn't be feared

Would you like to build your own gun? There are plenty of ways to do so, legal and otherwise. A group called Defense Distributed recently published instructions for creating a plastic firearm using a 3D printer. One guy even fired a real bullet with one.

The U.S. Department of State demanded that the group take the blueprints down, alleging they may violate export control laws. Defense Distributed complied, but not before at least 100,000 people had downloaded the plans.

Fears of teenagers printing a plastic arsenal are overblown, but the episode is emblematic. Three-dimensional printing, also called additive manufacturing, can be a powerful force for economic and social progress. It also holds potential for abuse: Weapons and counterfeit goods are just a hint of what an unscrupulous user might one day produce.

The questions are not only how this technology may disrupt our lives, for better and worse, but how to prepare for a manufacturing revolution in the making.

3D-printing a gun, like printing most other things, is pretty simple. You download a digital file for a design you like. The printer reads the file, then shoots out layer upon layer of specialized plastic-or another raw material-through a heated nozzle in the specified shape. Not long after, your gun parts materialize.

The technology is about 30 years old but has only recently become cheaply available and widespread. Global sales and services related to 3D printing reached \$2.2 billion in 2012, up 28.6 percent from the previous year, according to Wohlers Associates, a consulting firm that focuses on trends in the 3D printing industry. The firm expects that figure to reach about \$6.5 billion in 2019.

The economic potential is stunning. Across a range of industries, research and development costs are declining and product development cycles are accelerating

as more inventors experiment with cheap 3D-printed prototypes. Consider the Urbee 2, a car being produced by Kor Ecologic using a 3D printer. When completed, it will weigh 1,200 pounds. Made with about 40 pieces of thermoplastic, it will be resilient, aerodynamic, and mind-bogglingly efficient. It will need almost no labor and little time to assemble.

The issue now becomes whether the technology will transform manufacturing more broadly. At the moment, 3D printing is a small part of the economy. The printers are typically slow, and the material they use is expensive and inconsistent. As the industry advances, however, printing on demand could reduce assembly lines, shorten supply chains, and largely erase the need for warehouses for many companies. Cutting back on shipping and eliminating the waste and pollution of traditional manufacturing could be an environmental boon.

In a few decades, things could get really interesting. Engineers should be able to blend raw materials in new ways, endow products with nanotechnology and artificial intelligence, and create objects that interact with their physical environment. Imagine military armor embedded with sensors that track wear and tear, or a turbine blade that monitors its own temperature.

The technology is liberating entrepreneurs. As consumer-grade printers improve, basement enthusiasts will be able to make replacement parts for products they own, invent and sell customized objects online, and potentially create new industries. As Hod Lipson and Melba Kurman write in *Fabricated: The New World of 3D Printing*, the technology will be "the platypus of the manufacturing world, combining the digital precision and repeatability of a factory floor with an artisan's design freedom." In other words, the era of mass customization is quickly approaching.

But if 3D printing promises expansive opportunities, it will also present new

problems-as the plastic gun suggests.

The intellectual-property system will face plenty of new challenges. Whole categories of products will be newly subject to counterfeiting. Amateur printers are already appropriating pop culture artifacts to create clever new objects, copyrights be damned. And businesses threatened by this new technology will be tempted to drive newcomers out of existence or underground through lawsuits and lobbying.

Or consider product safety. Millions of new physical objects might be unleashed on the world-from strollers and action figures to junk food and prosthetics-the quality and safety of which will be highly variable. When those products malfunction or injure someone, possibly in another country, who's liable?

The medical uses of 3D printing are thrilling and terrifying. Printers are being used to make hearing aids, dental implants, and prosthetics. Hospitals are printing precise replicas of patients' organs to plan surgeries. Researchers are using 3D printers to arrange human cells to create bone and blood vessel tissue. Before long, we may be printing replacement organs. This holds great promise-but what happens when the power to create body parts on demand becomes routine? We lack even a moral vocabulary for this brave new world.

Finally, 3D printing seems likely to throw a lot of people out of work in the medium term, especially in industries that depend on assembly-line labor. Eventually, as with most technological breakthroughs, it will probably create new jobs in new industries. But that transition period will be hazardous, and displaced workers will need help to navigate it.

A recent report from the Atlantic Council, a Washington think tank, predicts that 3D printing "has the potential to be as disruptive as the personal computer and the Internet." The comparison is apt. 3D printing will make the world a very different place-and, with the right policies, a better one, too.

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