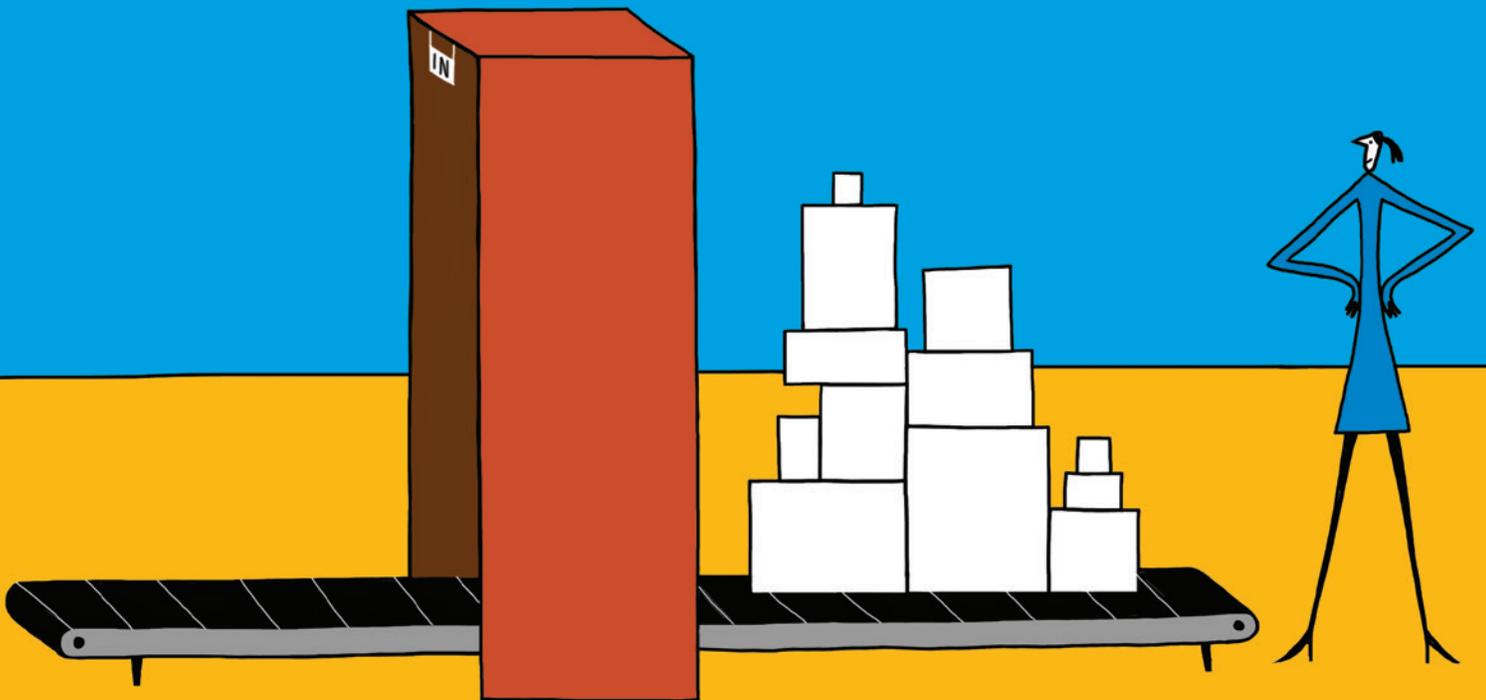


The Make-for-Me Future

SOME COMMODITIES ARE JUST COMMODITIES. EVERYTHING ELSE IS UP FOR GRABS. COMPANIES THAT CAN DELIVER MAKE-FOR-ME PRODUCTS CAN GREATLY INCREASE CUSTOMER SATISFACTION AND LOYALTY.



Last year, Volkswagen turned customers into car designers, inviting them to take control of its 3D printer to design their own versions of the carmaker's Polo model. Miniature versions of the 40 most creative customizations on the mini microcar were produced. The big winner saw a full-sized version of their car come to life – layer upon layer of special plaster-based powder, just the way the German automaker produces all of its prototypes.

It was the proverbial win-win. The amateur designer got a personalized new car; Volkswagen got an interesting new design and some good marketing.

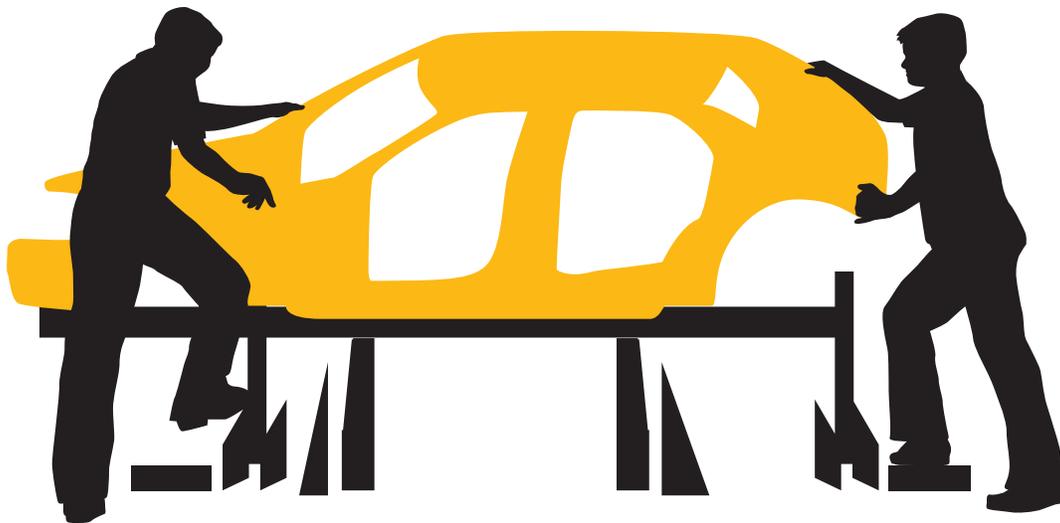
But what happens when every customer wants to put their own spin on a car? Or a toaster? Or a toilet?

Mass production will never die, but a new make-for-me model of manufacturing is emerging alongside it. A number of increasingly affordable production technologies – from 3D printers to computer numerical control (CNC) machines – are fueling the technology-driven do-it-yourself “maker movement,” further disrupting the traditional manufacturing business model. As a broad spectrum of customization emerges, from truly unique lots of one to the typical “list of options” model that exists today, companies will have to figure out where they fit in – and fit in profitably – on that continuum.

We are witnessing the beginning of the democratization, decentralization, and hyperpersonalization of manufacturing: just in time, just in place, and just for me. Access to lower-cost 3D printers, CNC machines, and a number of other technologies available at price points lower than ever before gives the public power that it wouldn't have access to otherwise.

In an increasingly connected world, customers can compare notes and collaborate, share their positive and negative experiences through social media, and interact directly with companies to tell them what they want and what they don't.

Manufacturers will have to rethink their design and production processes. Organizations will have to incorporate insights derived from continuous customer engagement at every step along the value chain and be willing to quickly – and constantly – redesign their business models in this make-for-me future.



Customization Goes Mainstream

Companies have been perfecting their methods of mass production for more than a century. Some things will always be mass-produced, such as those products that require massive scale, speed, and efficiency – producing millions of wire nails or deboning 110,000 chickens in an hour. Caterpillar will produce its million-dollar D11R bulldozer in Peoria, IL. Boeing and Airbus will crank out jumbo jets. Basic consumer packaged goods will be delivered at scale. And manufacturers will continue to mechanize and automate their processes to squeeze every ounce of cost and efficiency out of their supply chains.



There may never be demand for custom gasoline or custom industrial chemicals. Some commodities are just commodities. Customers won't care how those things are made; they just want the products. Everything else, however, is up for grabs.

In his book *The Great Reset*, Richard Florida argues that one of the consequences of the economic downturn has been the creation of a consumer class that's less acquisitive and more thoughtful. Instead of buying 20 dress shirts, they buy five. They look for something that's higher quality and customized. That sociological shift has coincided with the technological changes that could enable such individualization at reasonable cost. Customers who don't get what they want from companies will be quick to go to a competitor – or make it themselves.

The concept of product customization is nothing new. In the 1970 book *Future Shock*, Alvin Toffler introduced the concept of the consumer both producing and consuming a product. Seventeen years later, it was described by Stan Davis in *Future Perfect*. But thanks to a confluence of available technologies (see sidebar, "The Tools of the Make-for-Me Future") and prevailing consumer attitudes, the future is here.

The Tools of the Make-for-Me Future

A number of increasingly affordable production technologies are fueling the make-for-me movement. Computing power was once costly, complicated, and available only to a chosen few.

Now it is nearly ubiquitous. Similarly, industrial production machines are coming down in price, increasing in power, and entering the mass market. Here are five of the most important tools for custom manufacturing:

- **3D printers.** This is the technology that gets the most press these days. Employed by manufacturers for years to cheaply produce prototypes, 3D printers can create a three-dimensional object from a digital model by building up – or sintering – layers of material, most often plastic, but also ceramic, stainless steel, bronze, sandstone, and sterling silver. In 2014, key patents on the most advanced laser-sintering 3D printers will expire, further fueling competitive pricing in the market. The cheapest 3D printers cost as little as U.S.\$1,000.

- **Computer numerical control (CNC) machines.** CNC machines are the workhorses of make-for-me production. Researchers from the Massachusetts Institute of Technology, bankrolled by the U.S. Department of Defense, developed the first 3D numerically-controlled machine tool more than 50 years ago. The high cost of computing power, however, meant that CNC machines were no less expensive than human labor. But as processing power gets cheaper, CNC machines have begun to be deployed in lieu of man-operated alternatives, such as mills, routers, and lathes. Customization is getting easier as making alterations becomes a matter of reprogramming the software.

- **Laser-powered machines.** Laser-cutting machines use computer-controlled lasers to cut through such materials as wood, acrylic, plastic, marble, and fabric, leaving a high-quality finish. Once limited to large-scale manufacturing operations, their use by individual makers and start-ups is increasing. Laser-engraving machines use the same approach to engrave, etch, or mark materials, including wood, acrylic, plastic, glass, leather, fabric, coated metals, anodized aluminum, ceramics, Mylar, Corian, pressboard, and more.

- **3D scanners.** These scanners use multiple lasers to capture objects in three dimensions to digitize models for production, often on a 3D printer. The popular NextEngine 3D scanner retails for U.S.\$2,995. The MakerBot Digitizer desktop 3D scanner hit the market in October 2013 at U.S.\$1,400.

- **Single-ply cutting machines.** Capable of cutting a wide array of materials, single-ply cutting machines are an efficient option for smaller job lots, such as prototype, made-to-order, and supplemental production.

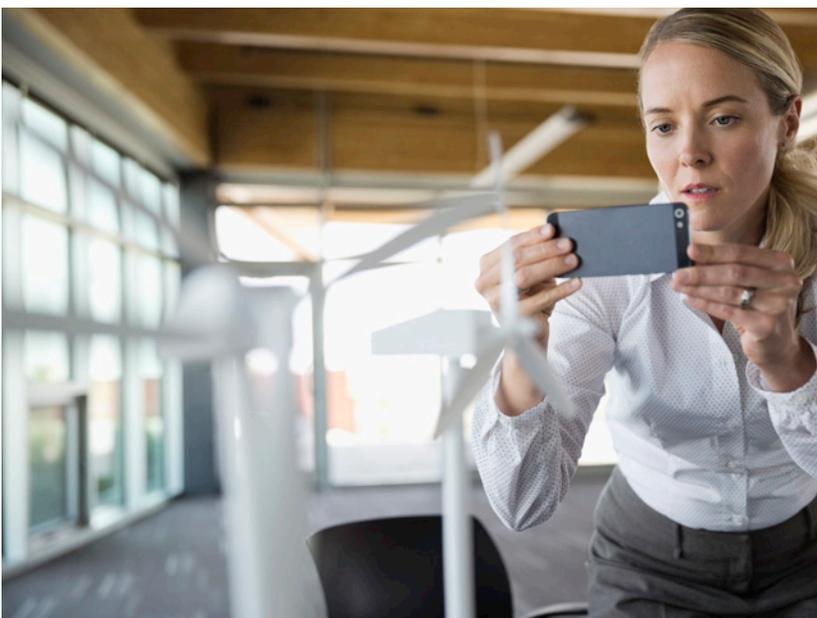



Frustrated Customers Can Take Action

Henry Ford is reported to have said, "If I had asked people what they wanted, they would have said faster horses." Steve Jobs echoed that sentiment, saying that customers don't know what they want until you show them. Those are typical 20th century notions. And they were wrong even then.

People weren't wandering around 1884 New York wishing for more horses, given the health problems that all the waste produced by horses caused. However, the ordinary person had no influence; solutions had to come from governments or corporations.

In the 21st century, that's being inverted. People have always been frustrated, but now they have more power, more influence, and more access. They have a voice and a means to do something about it. Consider Richard Van As, a carpenter who lost his fingers in an accident. Rather than spend tens of thousands of dollars on the only



Can Individuals Make It As Manufacturers?



Robohand

Customers who don't find the make-for-me products they want available in the market may not have to do it themselves, thanks to new production and collaboration technologies.

In 2012, South African carpenter Richard Van As lost four fingers in a circular saw accident. He went in search of a customized, fitted mechanical replacement for his digits and found none. There were options for those who had lost an entire hand, but nothing available for those who had lost fingers. The most advanced biomechanical prosthesis available was tens of thousands of dollars out of his price range.

After watching a YouTube video of a mechanical hand prop designed by amateur mechanical engineer Ivan Owen in the United States, Van As decided to solve his own problem. Collaborating through Skype and the Internet, the duo ultimately built a customized 3D-printed thermoplastic hand and fingers named the Robohand (published as open source, with no patent).

Unlike existing products, the Robohand technology uses the motion of existing joints to mechanically move the custom-made device without invasive surgery. Owen and Van As now create one-off mechanical fingers, hands, and arms for customers around the world at a cost of just U.S.\$500 each.

prosthesis available, he partnered with an engineer to design and 3D-print his own – made specifically for him – at a fraction of the cost (to read Van As's story, see sidebar, "Can Individuals Make It As Manufacturers?").

But what if that carpenter had found a company willing to create that robotic prosthesis for him? Companies who say yes to customers seeking made-to-order products could open up new markets for themselves.

Light-control manufacturer Lutron Electronics Co. Inc. had just two products when it was founded in the late 1950s. Today it offers over 15,000, due in part to founder Joel Spira's core principle of taking care of the customer. The company is more likely to say yes to a unique customer request than turn one down. As a result, it often comes up with a new product or service that increases revenue and market share. (For more on Lutron Electronics, see sidebar "Balancing Order and Chaos at Lutron Electronics.")

With more opportunities than ever before to elicit and incorporate customer input into product development – from social media, mobile, and sensor-enabled devices to automated feedback from software – the time is right for companies to create a real customer-driven supply chain.



The Rise of the Maker Culture

When Tim O'Reilly and Dale Dougherty launched Maker Faire, a festival that combines arts, crafts, engineering, and science projects, DIY style, in 2006, they had a reasonable turnout. Today, more than 150,000 people attend the bicoastal event. Etsy Inc., the e-commerce portal introduced in 2005 to give artists and craftspeople the opportunity to sell their handmade wares to a global audience, now has one million sellers and is on track to enable more than U.S.\$1 billion in annual transactions in 2013.

Breakthrough products are as likely to come from individuals sponsored through Web sites provided by companies like Kickstarter Inc. or Indiegogo Inc. as they are to come from manufacturers with hundreds of people working in research and development.



Balancing Order and Chaos at Lutron Electronics



Lutron Electronics Co. Inc. has built a profitable manufacturing and services business based on the principle of never saying no to a customer request. Lutron can match any color, such as that Benjamin Moore Palladian blue a customer painted the nursery, and deliver a light switch cover to match. Its new motorized window shade products can incorporate custom fabrics sent in by customers.

Lutron founder and chairman Joel Spira has said, "Our company's embrace of a profitable make-for-me model is governed by a constant tension between order and chaos, between standard modules and creativity in engineering, between costs and customization in production, and between customer satisfaction and information overload in sales." The chaos increases new business. The order boosts profitability.

The manufacturer focuses on four practices when customizing its products: creating common modular components across product lines, making sure employees continuously interact with customers, widening the ranges of functions and features in new and old product lines, and thinking ahead of customers.

Perhaps most importantly, Lutron thinks about how customers might want to alter or improve a product before they begin producing it in order to create profitable processes for make-for-me products.

TechShop Inc., one of the fastest-growing private companies in the United States, offers paying members access to 15,000 square-foot shops that have everything from 3D printers and CNC machines to a textiles lab and water jets. Start-ups like i.materialise, Kraftwurx Inc., Ponoko, Shapeways Inc., and Sculpteo operate brisk 3D-printing services and communities, connecting makers, buyers, and sellers of unique items from gadgets and games to jewelry and housewares. Shapeways has gone from producing approximately 7,000 unique printed items a month three years ago to about 70,000 a month today.

It's all part of the growing maker culture, a technology-fueled, do-it-yourself movement that is empowering people to build their own products and sell them to each other rather than buying from brands. It harkens back to the days of cottage industries, and home-based enterprises, from blacksmiths to bakers, carried on by family members using their own skills and equipment. But today these individuals have access to some of the same machines used by General Electric or Xerox Corp. to prototype their products at a fraction of the cost.

Clearly, manufacturers no longer have a monopoly on production tools. As TechShop CEO Mark Hatch says, "We're democratizing access to the tools of the industrial revolution." And the maker movement isn't bound by geographic limitations, with members forming communities and collaborating online and in social networks.

Whether they're creating bespoke goods from scratch, recycling old materials to create something new, or inventing an ingenious hack on an existing product, makers clearly no longer exist on the fringe. In fact, Jeremiah Owyang, founder of Crowd Companies, a consultancy that helps corporations with the collaborative business models, has said that the next generation will be more adept at creating products than they are at consuming them. And that's a threat to traditional manufacturers because it disrupts business models, ecosystems, and supply chains.

How Manufacturers Can Embrace Customization

Customization is an opportunity, but one that requires new thinking, innovative processes, and, sometimes, infrastructure changes. Companies have made tremendous investment in their mass production methods and systems based on a series of tightly integrated processes as demanded by mass production. Make-for-me manufacturing benefits from a system of more loosely linked autonomous units that can be configured as and when the consumer wishes. With increased customer data and real-time analytics power, manufacturers may get closer to predicting what a customer might ask for next. But the real goal is to be prepared, as Lutron Electronics is, to meet that request.

Make-for-me manufacturing is an easy sell in some industries, like aspects of the healthcare industry. Companies employ 3D printers to create personalized products like dental crowns or lightweight medical implants such as bone replacements, hearing aids, and surgical guides. The machine-building and automotive industries use additive manufacturing processes to produce easily customizable original parts in small batches. An additive process would be layering material with a 3D printer, in contrast to a subtractive process, which would involve cutting or drilling. For example, Kuhn-Stoff GmbH & Co KG built a highly customizable, lightweight pneumatic gripper with laser-sintering technology. It can be printed in one shot – with no final assembly – at significantly lower costs than a traditionally produced one.



The larger universe of manufacturers has been tinkering with their supply chains to figure out how to compete or integrate with the make-for-me world that is evolving around them. They are working in four main areas:

- **Retooling production lines and back-end systems to increase agility.**

1

Ford Motor Co. has what it calls a modular engine, which can be produced in several variations, from 4.6 liters to 6.8 liters and 8 to 10 cylinders. The engines themselves aren't modular; the line is. The plant and its tools can be swapped out in a matter of hours to manufacture different versions of the engine based on need rather than guessing what the demand will be.

- **Giving customers the tools to customize.**

2

The Coca-Cola Co. discovered that customers were mixing their own soda flavors at the company's retail fountains, so they decided to industrialize that urge to experiment. They created the Coca-Cola Freestyle fountain, giving soda buyers the ability to create their own concoctions from more than 100 different flavors. Other companies are incorporating personalization in their marketing campaigns, like Volkswagen AG. And it's all happening on an industrial scale.

- **Taking risks and gathering feedback.**

3

The make-for-me world rewards the company willing to take a chance on customization and to continually recalibrate based on customer feedback. Today, for example, Mars Direct, a division of Mars Snackfood US, is an entire business unit dedicated to customized candies and products. But that started more than a decade ago with a small R&D group that

wondered if offering custom colors and printing on M&M candies might be a viable moneymaker.

According to a BusinessWeek article, it started with one small printer and employees hand-bagging the candies with a strategy to "make a little, learn a little, and make a little more." So they did. The trial sizes enabled the company to calibrate pricing and lot sizes and led to the discovery that customers were willing to pay a significant premium for make-for-me M&Ms for, say, a wedding or corporate event. They launched the My M&M's service in 2004 through a link on the main Web site with little fanfare. Sales took off. The company continued to research customer wants, reaching out to everyone who commissioned the candies, a source which generated data much more valuable than traditional focus groups.

- **Gathering data.**

4

With access to more granular customer data and input, manufacturers can make smarter decisions about customization, not just offering an individual twist on a product because they can ("We're already printing an 'm' on the candy. What else can we print on it?"). They can make the shift because they are certain customers will want it. The more data companies can stitch together from devices, social networks, and customer communities, the smarter and more automated these make-for-me decisions will be.



“ AS COMPANIES OFFER MORE ONE-OFF PRODUCTS TO CUSTOMERS, THEY'LL IN TURN GARNER EVEN MORE VALUABLE DATA FROM THEM. THOSE THAT INVEST IN BIG DATA COLLECTION AND REAL-TIME ANALYTICS WILL BE POISED TO COMPETE IN THE ONE-TO-ONE MARKETPLACE. ”

As companies offer more one-off products to customers, they'll in turn garner even more valuable data from them. Those that invest in "Big Data" collection and real-time analytics will be poised to compete in the one-to-one marketplace. But they will need to make a change in mind-set as well.

While mass production is built around sacrificing everything to the efficiency of the machines and the manufacturing line, customization is about being agile and trying to eliminate customer sacrifice. That kind of thinking can be difficult to change in manufacturing companies, some of which have been around for a century or more. But customers will continue to push in this direction.

The Upside of Make-for-Me

For make-for-me to work, it must be as close to as cost-effective and speedy as its mass-produced counterpart, not high-cost and high-touch like a tailor-made suit in London. But when that can be accomplished, the make-for-me model can deliver a number of benefits to companies willing to embrace it.

There is the wealth of more granular and explicit insight that comes from a customer who orders exactly what they want from a manufacturer. Product customization can also be a cost-saver for companies. While manufacturing companies pride themselves on efficiency, there is significant waste in systems that offer something customers don't want. Approximately 60% of all apparel, for example, must eventually be discounted because no one wanted that particular size, color, or style.

Delivering the products customers want can ultimately be cheaper



for a variety of reasons. Inventory and associated carrying costs go down, often enough to outweigh the additional investment in make-for-me production. Meanwhile, customers are very often willing to pay a premium for a made-to-order product. Offering bespoke products can broaden a company's customer base as it reaches those with more diverse tastes than mass production can accommodate.

Most importantly, figuring out a way to incorporate the make-for-me mentality can be a competitive differentiator. With advances in technology and tools, that may not always be the case. But today, personalization creates the potential for huge increases in customer satisfaction and loyalty. If you enable customers to order the exact product they want instead of making them settle for 80% of what they want from a mass-produced product, the chances for complete satisfaction increase significantly.





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