3D Printing: Changing the Economics of Manufacturing Custom Components

Additive manufacturing is an efficient, cost-effective solution when customization is required.

Introduction

With traditional manufacturing technologies, the design and production of custom parts and products can be expensive and time-consuming. That's because the economics of mass production require a large volume of finished goods over which to amortize the significant costs of prototypes, tooling, setup, assembly, materials, and finishing.

Custom products, however, are manufactured in small lots, and for them, a different approach is required. One advanced technology that manufacturers are embracing for its ability to produce custom products quickly and profitably is additive manufacturing, or 3D printing.

3D printing has evolved tremendously from its beginnings some 30 years ago in the creation of simple plastic models. Advances in software, printers, and materials have allowed 3D printing to shorten the design-to-manufacturing cycle, and enable custom parts to be manufactured with high degrees of flexibility and accuracy.

Today's 3D printers can build larger parts with greater precision, at faster speeds, and at lower cost than ever before. They can now handle a range of materials, from engineering resins and elastomers, to metals, waxes, and bio-compatibles, and a growing list of material combinations that facilitates customization.

Increasingly, they are being used to build not just static objects, but complex, fully functional mechanisms, as well as parts with structural and other features that simplify and reduce assembly time and cost. Indeed, they make possible parts and products that can't be produced cost-effectively by any other method.

What's more, manufacturing professionals are no longer limited to massive 3D printers that are expensive and unsuitable for an office environment. Today's affordable, compact units are expanding in-house 3D printing capabilities and increasing the availability of high-quality prototypes for custom products. Here are some of the ways in which 3D printing is enabling manufacturers to create custom products better, faster, and less expensively.

Better Prototypes Lead to Faster Custom Designs

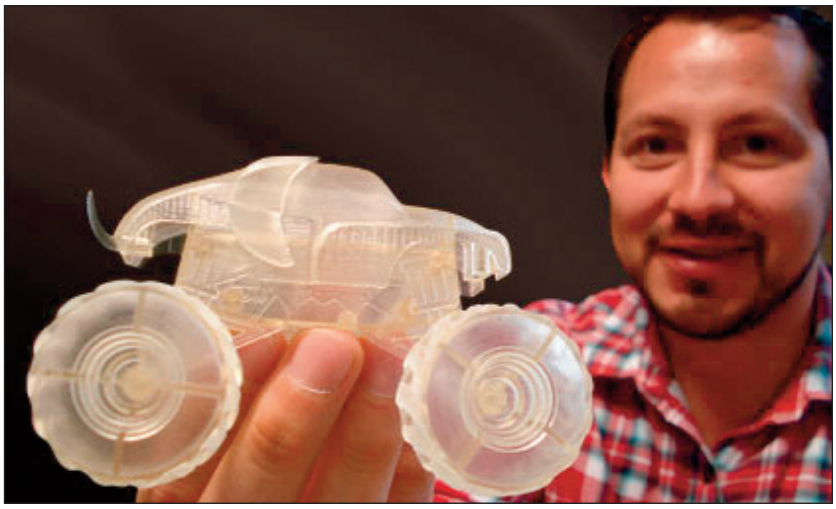
A key benefit of 3D printing has always been its ability to speed the creation of prototypes, thereby helping to slash product development times. Now, however, prototypes with much higher degrees of complexity, fit, and finish can be produced that help users better envision the final product. This enables them to provide more detailed feedback that, in turn, further reduces product development times.

For example, Mexico City-based Bondy Fiesta manufactures and exports a wide range of toys, including mini toys for the novelty candy market, and budget toys under license to some of the world's best-known brands like Barbie, Disney, and Nickelodeon. These licenses are granted for limited periods of time only, which requires Bondy Fiesta to complete product design and development within strict deadlines.

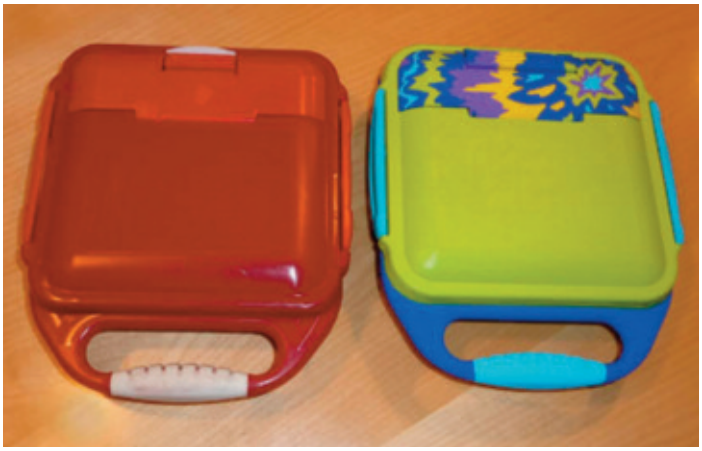
Before the company installed an in-house Objet Eden260V 3D printer, it relied on an external supplier for modeling and prototyping, with each prototype feedback cycle taking two or three weeks. But the prototypes weren't highly realistic, and design errors often weren't discovered until the fabrication of production molds was well along.

This led to serious delays in production, which frequently prevented the company from taking advantage of the full licensing period it had purchased.

The Objet printer has enabled Bondy Fiesta to reduce to a single day some processes that previously took up to three weeks. In addition, design errors have decreased by some 80%, and they are now discovered and resolved much earlier in the process. "We now provide much higher-quality products,



Bondy Fiesta decreased time to market for its toys and improved quality with an in-house Objet 3D Printer.



Cool Gear products, including lunch boxes and water bottles, are made with a Dimension 3D Printer.

more innovative designs, and faster development," said Roberto Aguilar Marquez, Bondy Fiesta's marketing director. "Our licensing companies have realized we are capable of handling much more complex orders and we have been offered more projects."

The ability to produce better and faster prototypes for custom products also gives users a competitive advantage in addressing the needs of fast-moving markets such as consumer products, where tastes and preferences are fickle and apt to change quickly or unexpectedly.

One example is Cool Gear International, which supplies innovative, imaginative food storage containers and hydration products. While a water bottle may not appear to have a complex design, Cool Gear produces them in unending varieties to meet wide-ranging customer wants and needs, while at the same time looking, well, cool.

Some bottles have caps with a built-in straw that makes them easier to use, some contain a freezer stick to keep water cold, and others have a filter that filters up to 150 gallons of water. Taking customization to an extreme, Cool Gear even allows users to design their own bottles by submitting background designs, photos, and text.

Moving these products from concept to market was once a lengthy and expensive process involving manufacturing plants outside the United States. It took several months, instructions often were jumbled in translation, and things were made all the worse because of the multiple design iterations often required.

When Cool Gear brought prototype design in-house with a Dimension 3D printer, it allowed designers to put more time into designs and see the results in a physical sample quickly. "The Dimension has given us a competitive advantage," said John Mason, Senior Product Developer.

"We can bring our designs to the next level of form and function. Before, we could look at something on a screen for a long time, but we still couldn't see the issues we can see now with prototyping. It might be something as simple as sizing, or how a product feels in someone's hand, or how a cap might interfere with someone's face while they are sipping. The Dimension helps us design a better product. I don't know how we did it before."

Design Flexibility Leads to Economical Customization

The design-for-manufacturability (DFM) philosophy of recent years has placed great emphasis on various techniques aimed at reducing errors, rework, materials usage, and production time. While these benefits are important, when it comes to product design, the DFM philosophy tends to impose limitations on customization rather than facilitating it.

That's because with traditional production technologies, designers must place an emphasis on manufacturability concerns, whereas 3D printing frees them to place the emphasis on addressing specific use, form, or appearance requirements because no changes to tooling or production flows are required to switch from producing one part to producing a different one. Germany's Wincor Nixdorf International GmbH is a case in point. Wincor Nixdorf offers hardware and software solutions and associated services that allow its financial-services clients to optimize bank transactions, reduce processing costs, and improve customer service.

Among its state-of-the art products are a complete range of automated and self-serve products, including customer self-service stations for bank cash machines. To guarantee safety and security, the components of these self-service stations need to be updated and improved on an ongoing basis. That, in turn, means prospective new designs need to be shared with customers quickly.

Normally, that would take two to three weeks using traditional toolmakers who might fabricate as many as half a dozen prototypes. But using a Dimension 3D printer, Wincor Nixdorf's product development team recently was able to present a complete range of new slots for a cash machine to a client within two days.

Wolfgang Hamann, Wincor Nixdorf's Product Manager for Transaction Terminals, said, "Customer service makes a difference in our business. Especially within a fast-moving industry such as banking, the ability to come up with immediate solutions is of vital importance, and Dimension helps us accomplish just that."

In the coming years, such design flexibility likely will make 3D printing a key enabling technology for the growing number of

The purchase of a Dimension 3D Printer enabled Cool Gear designers to see the results of their efforts in a physical sample almost immediately.

crowdsourced product designs, where ideas are solicited from ad hoc groups of people via the Internet by crowdfunding firms such as Kickstarter, Indiegogo, Quirky, and others. The goal is to conceive of, fund, and produce imaginative new products for niche markets faster and more cost-effectively.

Indeed, in the future, 3D printing's flexibility may well alter how companies decide to conduct their research and development activities altogether, given that its software-based designs enhance remote cooperation so efficiently.

3D Printing Enables New Manufacturing Strategies

As 3D printing moves beyond prototypes and into full-fledged manufacturing, the economic implications are significant. Research from the McKinsey Global Institute suggests the technology could have an overall economic impact on manufacturing of up to $550 billion a year by 2025.

3D printing helps to reduce the cost of manufacturing custom products in several ways. One is that it enables users to quickly and cost-effectively produce the specialized tooling and fixtures needed for production of custom parts.

For example, Rutland Plastics is a custom injection molding company in the United Kingdom that produces a wide range of products for many different customers. Each project is unique, so Rutland must create special jigs and fixtures to position and hold components during manufacturing operations. Traditionally, the company made about 100 aluminum jigs and fixtures annually using CNC milling machines, at a cost of some $150,000 per year.

Because each new jig or fixture took three days to create, Rutland was tying up the equivalent of one CNC machine for 300 business days annually just to build production tooling, instead of using it to build products that could be sold to generate revenue.

After installing an Objet350 3D printer, Rutland reduced its annual cost to produce jigs and fixtures to $90,000, a $60,000 (40%) savings, and reclaimed its CNC machines exclusively for revenue-generating processes. Moreover, the company is now able to produce the customized parts 66% faster than with CNC milling.

Another way 3D printing helps to reduce the manufacturing costs of custom products is that it gives manufacturers the freedom to allocate resources and to partition production in the most efficient and cost-effective ways possible.

For example, Sweden-based DST Control supplies advanced embedded electromechanical products for unmanned aerial and ground vehicles. These are used for surveillance, law enforcement, and mapping. Among DST Control's products is a miniature, high-performance, electro-optical gimbal – essentially an electronic eye – that remains stable despite the motions of the vehicle carrying it, so that it can produce accurate images at high resolution.

To maintain its market lead, DST Control must commit to fast response and short delivery times despite the fact that most of

Using a Dimension 3D Printer in the development process, Wincor Nixdorf shortened their international production time and quickly created solutions to meet client needs.

DST Control's electro-optical gimbal – essentially an electronic eye – is mounted on a helicopter and tested.

its deliveries include some element of customization. Previously, the company used techniques such as outsourced CNC milling to manufacture the aluminum core of its products. But this became problematic for three reasons: fast-rising costs, a critical dependency on suppliers who tended to prioritize higher-volume orders, and the fact that some parts require customization, which was time-consuming.

DST Control developed a strategy to combine traditional production methods with modern in-house production techniques such as 3D printing. The idea is to produce the parts needing customization in-house out of plastic using 3D printing, while outsourcing standard aluminum parts to be made via conventional processes.

Since installing an in-house Fortus FDM (fused deposition modeling) 3D printer, DST Control has been able to deliver customized units in four weeks, rather than the 10 to 12 weeks competitors require. Moreover, by replacing expensive, lead-time-critical CNC-milled parts with plastic parts manufactured in-house, DST Control has reduced the part cost to one third.

Summary

As these examples show, 3D printing offers a number of important advantages to those who must design and manufacture custom parts and products. 3D printing means greater design freedom, better and fewer physical prototypes, compressed design-to-finished-product cycles, and custom parts that can be produced faster and more cost-effectively than with other methods.