

FOUR WAYS 3D PRINTING IS SHAPING PRODUCT DESIGN AND MANUFACTURING

HOW THE MOJO® AND UPRINT® LINES OF DESKTOP 3D PRINTERS ENABLE USERS TO TURN DESIGNS INTO REALITY WITHOUT LEAVING THEIR DESKS

Product engineers and tooling manufacturers have much to gain from 3D printing: By generating low-cost physical prototypes early in the design process, they can check form, fit and function; gauge customer response; and compare design iterations without commitment. It's even possible to quickly craft end-use parts, customized for a particular job.

And no longer are manufacturing professionals limited by 3D printers that are too big, unfit for the office environment, and prohibitively expensive. Today, affordable, compact, office-friendly units are moving 3D printing capabilities to the desktop and dramatically expanding the availability of high-quality prototypes and parts.

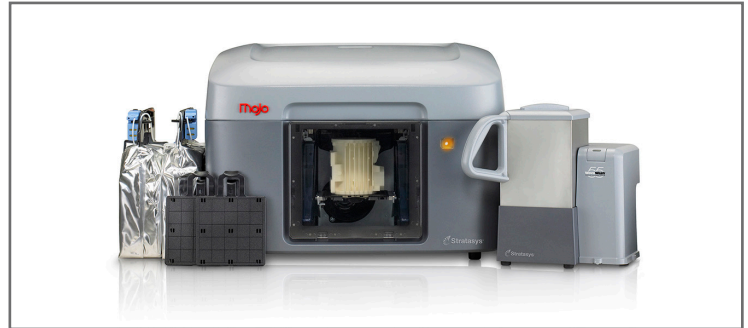
This white paper will describe how the affordable Mojo and uPrint lines of desktop 3D printers from Stratasys® enable users to turn designs into reality without leaving their desks. Through case studies and expert perspectives, readers will learn about applications in the following areas:

- Making ideas tangible in the conceptual design stage
- Preparing functional prototypes
- Crafting jigs and fixtures for manufacturing
- Creating custom end-use parts

In the span of just a few decades, 3D printing has gone from being the stuff of science fiction to a valuable driver of real-life product design and manufacturing. Today, the technology is helping companies in a wide range of industries to realize their design ideas at every stage, from concept to end-use parts — and to save time and money while doing so. What's more, the diversity of 3D printers available in the marketplace now makes it possible for even very small start-ups to implement this paradigm-shifting technology.

Product engineers and tooling manufacturers, in particular, have much to gain from the efficiencies that in-house 3D printing can create. Generating inexpensive, yet highly accurate prototypes early in the design process allows manufacturers and engineers to check form, fit, and function without committing significant resources. They can rapidly gauge customer response to an item, adjust the design and produce multiple iterations to compare alternatives. They can even quickly craft end-use parts that are customized for a particular job — and they can do all of this in hours or days, not the weeks or months that are required for traditional outsourcing to machine shops.

What's more, manufacturing professionals are no longer limited to massive 3D printers that are both expensive and unsuitable for an office environment. Today's affordable, compact units, exemplified by the Mojo and uPrint lines of desktop 3D printers, are expanding 3D printing capabilities and increasing the availability of high-quality prototypes and parts.



MAKING A REAL IMPACT IN THE REAL WORLD

To illustrate how owning a 3D printer can improve business workflows, we'll explore how two very different companies — Worxsimple and Redshield Technology — are utilizing their 3D printers to enhance manufacturing processes.

Based in Sandy, Utah, Worxsimple, LLC, is an original equipment manufacturer of custom medical parts and equipment. The company's engineers create prototypes and test fixtures on their 3D printers. To meet their various needs, Worxsimple uses three Stratasys 3D printers: the Mojo, uPrint, and Objet®30 Pro™.

Both the Mojo and uPrint employ FDM technology, which crafts extremely durable parts by extruding thermoplastic. In contrast, the Objet30 Pro features PolyJet™ technology, which operates in a similar fashion to an inkjet printer (instead of jetting ink, it jets layers of photopolymer resin that is cured with UV light) and is useful for parts that require fine feature detail.

It's easy to see how the company's needs evolved, says David Baker, owner of Worxsimple. "We had the Mojo first ... I think about four months, and it was always full and we could never really get in [all the print jobs that were in queue]," he explains. That spurred the purchase of the uPrint. Soon after that, they realized the need for a printer with enhanced surface texturing and accuracy, which was satisfied with the Objet30 Pro. "Having all three [printers] has been pretty beneficial in the machine design business because we can build pretty much anything we want," he says.

The second company, Redshield Technology, is an agricultural machinery manufacturer based in North Liberty, Iowa. Using a uPrint SE Plus®, its designers create 3D printed parts for sensor brackets, computer module housing and exterior trim pieces for machines that test soil composition. Because Redshield Technology is a start-up with a limited budget, owner Stacey Schildroth was very concerned about the cost of producing parts. Owning a 3D printer seemed to be the logical answer.

“With the 3D printer, we have more control of profitability,” she explains. “We can print as many parts as needed. We avoid the downtime that outsourcing would have involved. And we are able to maintain better quality control, since it is now in-house. Having our own 3D printer improves the bottom line dramatically, as it pays for itself so much faster than going to an outside party.”

TURNING CONCEPTUAL DESIGNS INTO TANGIBLE MODELS

Producing realistic physical models by traditional methods is time consuming, but the models are a necessity if clients are to fully comprehend a project’s design intent. With in-house 3D printing, professional models can be created very quickly to demonstrate designs, illustrate assemblies and identify potential problems before resources are invested in tooling and production.

For Worxsimple, buying a 3D printer was a leap of faith, says David Baker. He explains that although he was very excited from the start about incorporating a 3D printer into his workflow, he was somewhat overwhelmed by the range of possibilities. However, he quickly realized the breadth of what he was able to do with the technology and how it would fit in with his company’s business process.

“I remember one night I woke up at 2:00 [a.m.] and I started doing all these SolidWorks drawings,” he recalls. “I drew the parts out. I came in the next day. I printed them [on the] Mojo, and it was one of those days like, ‘Wow! That worked! I can’t believe it.’ And it just kept building on itself.” Now, all three of Worxsimple’s 3D printers are in near-constant use, turning their designers’ concepts into reality.

For Redshield Technology, which is still in the startup phase,

the focus is on keeping costs minimal — and that includes maintaining a small inventory. Since it takes only a few hours to create a new part with the uPrint 3D Printer, workers can create parts on a just-in-time basis. This speed also helps them turn around orders rapidly; workers can fully assemble a soil-testing machine in less than a day.

Schildroth explains that Redshield also seeks to control costs by making each CAD model as accurate and complete as possible before it’s sent to the 3D printer, so reprints won’t be needed. “However,” she continues, “from that point on, the printer is always involved — from the first prototype to production parts that go on the final assemblies shipped to the customers.”

PREPARING FUNCTIONAL PROTOTYPES

Physical models are also important tools for testing a product’s accuracy and viability. Unfortunately, when outsourcing the creation of such a model, manufacturers can’t be certain that the fit, strength and texture will be right. In addition, long turnaround times may lead to delayed projects and the loss of business and profitability. An in-house 3D printer enables companies to evaluate performance and fine-tune products without committing to production tooling.

“It’s very cost-effective for us to do our initial bids [this way],” explains David Baker. “We can push ‘Print’ [on any of our 3D printers] and go home, see our families and come back the next morning and put our parts together. They look great. They’re very pleasing to the eye, and they perform as well as any machined part in a low-stress situation.”

He noted that one particularly useful benefit of prototyping with a 3D printer is that it eliminates errors due to version-control issues. “We have a lot of scrap parts and if you’re going through a lot of changeovers, or you’re still redesigning your machine with very minute differences between the parts, you can accidentally put the wrong part in the final device,” he explains. “With the rev control [number printed] on the part, that really saves us a lot of headaches later on down the road.”

Schildroth also believes that the uPrint has helped improve



Each part produced on a 3D printer can be uniquely identified with its own rev control number.

Redshield Technology's prototyping significantly, and observes that the 3D printer really pays off when time is critical. "We were in a situation last spring where we needed to deliver a prototype to a customer that was evaluating our machine for a possible purchase," Schildroth says. "Unfortunately, we found an error in the design only days before delivery. We were able to redesign the part, get it printed on the uPrint SE Plus, and assemble it to our machine without missing our delivery date. We would never have been able to do that if the 3D printer weren't in-house."

As other Stratasys customers like Digi, Oreck and Thogus / rp+m have shown, financial justification of a new 3D printer based solely on jigs and fixtures can be quite easy and the outcome quite profitable. The important elements of these justifications are to equate the ease and simplicity of AM with more fixtures put into service. Then carry the savings out to the production floor to calculate labor reduction and profit gains from getting product on the shelves sooner.

CRAFTING JIGS AND FIXTURES

Custom-made tooling and fixtures can be produced as needed on a 3D printer, improving a company's ability to respond to customer

demand. Strong, durable jigs and fixtures can be created in one night instead of weeks.

"We bought [the Mojo] primarily to do prototyping for our fixturing that goes into our final machines," says David Baker. "We would do some development work and test them on the machines, and then later on we would convert to a stainless steel part or aluminum part before we finally shipped it. As we started working with Mojo, we found out how accurate and how reliable the parts were that came off of it. We started using it for more brackets and even more special widgets that we would ship with the final product to our customers."

Printing out components overnight and using them the next day provides substantial time savings, he notes: "You're cutting days and weeks out of the lead time for building machines."

CREATING END-USE PARTS

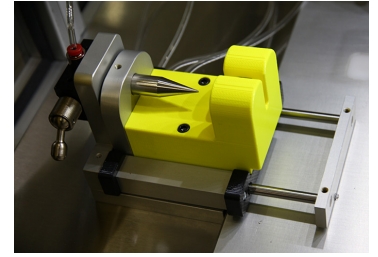
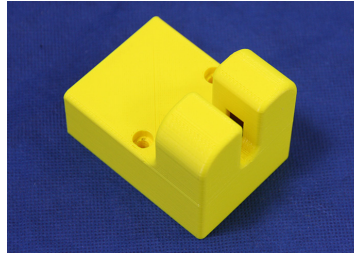
A 3D printer can speed up the tooling process — but it can also enable manufacturers to skip it completely. Both Mojo and uPrint utilize production-grade thermoplastics for their models, so users can simply print end-use parts directly from CAD files.

"Since we sell a high-value, low-volume product, we utilize parts off the uPrint SE Plus for both prototyping and production," says Schildroth. "It saved us from having to invest in high-volume tooling, and we can change the design immediately if needed."

"Our customers are really surprised that we can create our machines in-house using a 3D printer," Schildroth continues. "They're impressed with the level of detail involved, the quality of the parts, and the durability. If we don't tell them that the parts are made on a 3D printer, they would have no idea."

When building a part or a machine, if it looks like it'll work, that's half the battle, according to David Baker. "If everybody feels very good about it and is very positive about a machine that you're building, then they will go that extra mile to make sure that it'll work," he says. "I think 3D printing really lends itself to making something [that's] very aesthetically pleasing. The curves of the devices, the curves of the parts, it really improves the look of a machine."

The most important aspect of uPrint, believes Schildroth, is that it dependably produces quality parts. “We looked at less expensive ‘prosumer’ models,” she says, “but it seemed that you were forever tweaking and adjusting them to get good parts out. This is our business and we can’t afford the time to print multiple parts before we get a good one. With the uPrint SE Plus we can send the design to the printer and rely on good parts being built.”



Worxsimple uses 3D-printed parts, such as the yellow point guard shown here, in prototyping and end-use applications.

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