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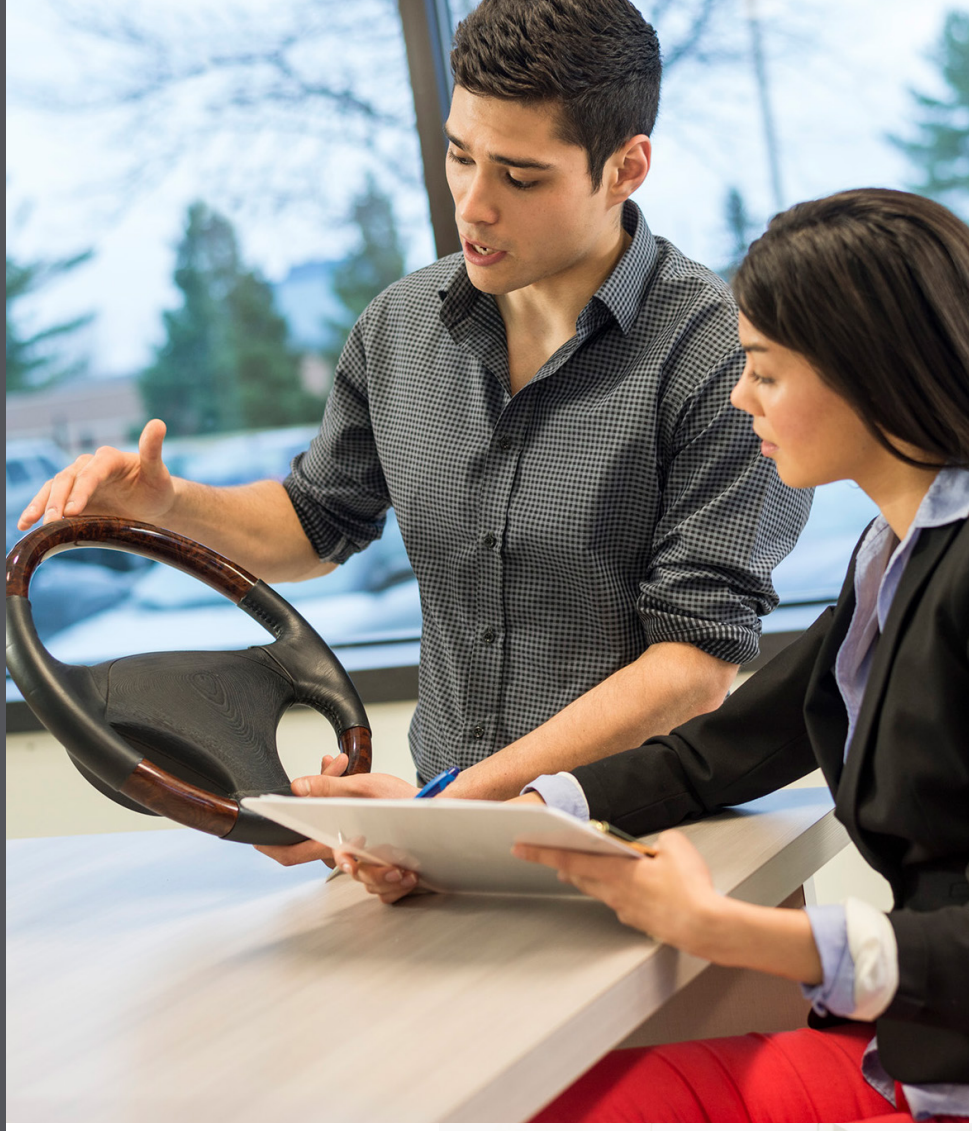

A Revolution in Design

How 3D Printing Helps Build Better Products Faster

stratasys

White Paper

A Revolution in Design

Since 3D printing's inception, system reliability and model quality have increased, resulting in diverse applications. In an IDC 2017 report, worldwide spending on 3D printing will reach nearly $20.0 billion by 2021 with a five-year compound annual growth rate (CAGR) of 20.5%.

Trends toward affordability and ease of use are bringing professional 3D printing technology in house for many designers and engineers. The growing expectation that a CAD drawing can become a real three-dimensional object in a matter of hours is altering how companies see the design process. It can be faster, more effective and less costly.

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From left to right, the helmet camera mount, final helmet, mouthpieces in red and white, and the helmet prototype at CAD.

Making It Quicker

The longer a product stays in the design cycle, the longer it takes to get to market, meaning less potential profit for the company. Time-to-market considerations are one of the most critical daily issues facing product designers and developers. For many, prototyping itself presents a time-to-market obstacle in product launches.

With increasing pressure to get products to market quickly, companies are compelled to make quick yet accurate decisions during the conceptual stage of design. These decisions can affect the majority of total cost factors by establishing material selection, manufacturing techniques and design longevity. 3D printing can optimize design processes for greatest potential profit by speeding iterations through product testing.

For example, Center for Advanced Design (CAD), a small product design firm, accelerated their development process and increased productivity by prototyping in house on their Stratasys F370™ 3D Printer.

"3D printing prototypes gives us the ability to fail fast. We can produce multiple design iterations quickly and we can change a product design overnight to meet a customer's deadline. The parts are accurate and the process is dependable," said Jesse Hahne, co-owner at CAD.

The journey from brilliant idea to successful product is fraught with hurdles. Analysis of product development by Greg Stevens and James Burley in their oft-cited study "3,000 Raw Ideas = 1 Commercial Success," found that in addition to 3,000 raw ideas, a single successful innovation also requires 125 small projects, four major developments and 1.7 product launches. If and when companies determine concepts are worthy of development resources, investing in 3D printing capabilities can speed the process.

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The helmet prototype was 3D printed in one build on the Stratasys F370.

While outsourcing 3D printing might result in models equal in quality to those 3D printed in house, there are benefits of investing in your own machine. A highly iterative process can only happen in a feasible time frame when engineers can see quick feedback on design changes. In house 3D printing eliminates shipping delays and reduces administrative slowdowns that can accompany sourcing prototypes from external services. With some systems, one in-house model per month justifies the cost of a printer versus money spent outsourcing.

Making It Successful

3D printing can increase the chances of a successful product launch by enabling more thorough design evaluations and a more iterative process. At Brooks Running, validation of new shoe designs is a huge component of their business. Once Brooks' designers create seasonal models, outsole and midsole prototypes are 3D printed in house on a Connex3™ 3D Printer. Before the ability to 3D print, the footwear company used service bureaus, jockeying to get a place in their queue to meet tight deadlines.

Printing on-site means the company doesn't have to get in line with a vendor or pay a rush fee, saving thousands of dollars per season. "We aim to build the best performance product on the market and now we have a new tool to help us get there. Our 3D printer has revolutionized our entire design validation process," said Kenny Krotzer, a Brooks' associate footwear developer. In addition to saving time during the design iteration

TIME SAVED PROTOTYPING WITH 3D PRINTING

vs. other methods

- **INDUSTRIAL DESIGN** Clay Models 96%
- **EDUCATION** Outsourced Machining 87%
- **AEROSPACE** Laser Cutting 75%
- **AUTOMOTIVE** Aluminum Tooling 67%
- **AEROSPACE** CNC Tooling/Injection Molding 43%

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Brooks' 3D printed mid-sole and out-sole prototypes.

process, the company also saves $500 to $800 per shoe design.

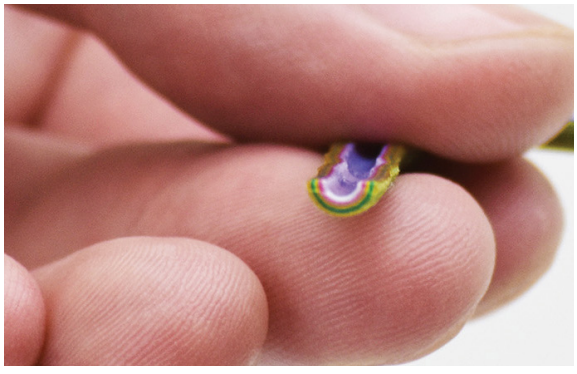
Successful product design requires review and input from many sources. With in-house 3D printers, design teams can review concepts earlier with others who may provide feedback. Fast collaboration with engineering, marketing and quality assurance can empower designers to make adjustments throughout the design process and follow-up testing.

Faster turnaround is the only way to enable iterative discovery without lengthening the design process. 3D printing users in aerospace, automotive, industrial design and education have reported improvements of 43 to 96 percent in prototyping speed when switching from traditional methods to 3D printing. Traditional prototyping methods include injection molding, CNC machining, metal machining and 2D laser cutting. In some cases, lead time required by a machine shop has been a major factor in slowing prototype creation.

As the trend toward affordable 3D printing continues to result in more decentralized machines, for example in departments or individual cubicles, opportunities to speed the design cycle are multiplying. An optimized design process with more prototype iterations can help minimize risk of product failure. Because 3D printers can produce models with fine feature details and the strength to withstand rigorous testing, designers can be more confident in their work. Additionally, data integrity and security is paramount in a competitive environment. While sharing confidential STL files with trusted vendors is generally safe, having a 3D printer in house removes any worry that might stem from sending intellectual property offsite.

Making needed changes as early as possible saves money and time. 3D printed models can give designers and engineers a thorough understanding of potential products earlier in the design process than other methods, minimizing the risk that problems will go unnoticed until it's too late.

Cardiovascular Systems, Inc. (CSI), a medical device company focused on developing and commercializing solutions for treating peripheral and coronary artery disease, works continuously to advance their devices and develop new innovations. Work that relies greatly on a wide scope of 3D printing applications. "3D printing gives us the versatility to rapid prototype, test our device from a reliability standpoint and print case recreations," said Jake Draxler, a CSI product development engineer. "We take those learnings, go back to the lab, improve things, and are continuously striving to develop products that are both safer and more effective."



CSI's 3D printed lesion model that uses multi-material and multi-color PolyJet materials.

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CSI's innovative drive has expanded their utilization of PolyJet™ and FDM® 3D printing across all facets of their business, greatly benefiting patients through successful treatment of atherosclerosis. With 3D printing in house, CSI is able to develop and test their devices responsively, advancing benchtop testing and improving physician training with 3D printed models of complex cases.

Making It Cost-Effective

The acquisition cost of a professional 3D printing system can be as little as $10,000 (USD), which may surprise engineers and designers who've priced larger 3D printers. Annual operating costs are generally lower too, partly because small to mid-range 3D printers require no dedicated facility or special expertise to run. Leasing options can mitigate the cost barriers that may have restricted adoption of 3D printing technology in the past. Other costs to consider are printer maintenance and material costs, which vary depending on use. When evaluating 3D printing systems, consider facilities requirements; expertise needed to run the system; accuracy, durability and size of models; available materials; speed; and, of course, cost.

Your desired application will help you determine the best system for you, but keep in mind that many users report discovering diverse uses after acquiring a 3D printing system. For example, a system purchased for functional prototypes might prove useful for building manufacturing tools.

At Indaero, a leading aerospace engineering and manufacturing specialist, in-house FDM 3D printing means Indaero can manufacture more complex tooling on demand, opening the door to rapid and cost-effective low-volume production for industry leaders like Airbus.

"With much of the competition limited to only a few services, we invested in additive manufacturing to not only enhance our processes, but extend into new tooling applications to further differentiate ourselves as an end-to-end, designto-production service," said Indaero CEO Darío González Fernández.

3D printing provides a highly cost-efficient means of producing numerous design iterations and gaining immediate feedback throughout the critical beginning stages of the development process. The ability to refine form, fit and function quickly can significantly improve production costs and time to market. This can create a distinct competitive advantage for those companies who include 3D printing as an integral part of their design process.

Lower costs will continue to expand the 3D printing market across industries, especially in small to medium-sized businesses and schools. The speed, consistency, accuracy and low cost of these printers will help companies reduce time to market and maintain a competitive edge.

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