Breaking The Barriers

How We Made
Rapid Prototyping Smarter,
Faster And More Productive

stratasys

White Paper

Breaking The Barriers

3D printing's contributions across the design, engineering and manufacturing disciplines are not new. The technology has been available in various forms for over thirty years and is often lauded as the next industrial revolution.

Despite some inflated claims, there's no denying that 3D printing, also referred to as additive manufacturing, has achieved its place as a valuable design and manufacturing methodology, and a cornerstone of rapid prototyping (RP). It lives up to the promise of making businesses more competitive by giving them the tools to streamline and enhance the product-creation processes.

Making You More Profitable

It's no secret that businesses need to quickly respond to changing customer and market demand to stay competitive. That's true for small design firms as well as large, established manufacturers. Getting a new product out before your competition helps you generate new revenue and maintain market leadership. But doing that is not easy, particularly if you're competing on the same level as your competitors and using similar technology and processes.

Changing your product development methodology to incorporate additive manufacturing is a proven means to gain a competitive advantage. It can drastically reduce new product development time and provides the ability to refine designs optimally to ensure they're ready for market.

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This motocross helmet and the attached red accessories were prototyped and 3D printed using the Stratasys F370 3D Printer.

However, embracing this technology or broadening its use, is often avoided for a number of legitimate reasons. Investing in professional 3D printers can pose a significant financial hurdle and companies find it difficult to justify the cost, especially for small to midsize companies. Many types of additive manufacturing require comprehensive knowledge of the process and equipment. That typically means hiring new employees, increasing the payroll.

Even companies that already use 3D printing for rapid prototyping face challenges making the most of this technology. If the 3D printers aren't readily accessible to the users, if the workflow is cumbersome and complicated or the equipment is unreliable, benefits will be minimal from inefficient use.

Choosing to stay with the status quo using traditional rapid prototyping methods poses risks, too. In the race to develop new products quickly, chances for field failures increase because there is not enough time and resources to adequately vet and test more than a few design iterations. It's simply too costly to develop multiple designs using the old methods, particularly if portions of the process are outsourced.

So what simple, reliable and efficient technology is available to help product developers become more competitive? The answer lies with a new professional 3D printing platform designed to increase the efficiency and simplicity of the rapid prototyping process. These FDM® (fused deposition modeling) 3D Printers provide solutions that help companies become more competitive through RP adoption and improve their existing RP processes.

To understand how they achieve this, let's take a closer look at how these 3D printers address the typical challenges CEOs, engineering and prototyping managers face in the product development process.

The Challenge: Slow Process

"It takes too long to develop new products, which increases the chance that our competitors will get to market first. This can negatively impact our ability to generate new revenue. We also don't have sufficient resources to fully test multiple design iterations, leading to a higher risk of field failures and declining revenue. We need a simple system that speeds up all facets of the RP process."

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How We Make Things Quicker

The hallmark of the Stratasys F123™ 3D Printer Series is that it is designed to meet the needs of the total RP process: concept verification, design validation and functional testing. And it will do this with economy and speed in a workgroup setting.

Rather than using less-optimal materials, printers or service bureaus for early iterations, Stratasys F123 Printers can quickly create multiple options for design or customer review. Multiple material choices include economical PLA or the durability of engineering thermoplastics like ASA, ABS and PC-ABS.

The same benefits apply to the design validation phase. The ability to produce multiple designs much faster gives you the time to refine and optimize the design. The durability of engineering-grade plastics also makes functional tests possible, ensuring the final part will operate as intended.

Prototyping in-house with local 3D printers also protects your intellectual property. There's no risk that confidential design information will fall into competitors' hands through outside machine shops and service bureaus.

The Challenge: The Lack of Expertise

"We don't have the expertise to operate a 3D printer, nor the budget to hire additional specialists to work with them. We need a rapid prototyping technology that's easy to use and can be shared by multiple engineers in our group."

How We Make Things Simple

Most 3D printing platforms require trained individuals knowledgeable about printer operation, file manipulation and troubleshooting. The Stratasys F123 Series printers are designed for ease of use, from the initial setup through the design-to-print workflow.

The printers employ a plug-and-play architecture, with automatic setup and test functionality. Once the printer is powered up and completes these steps, it's ready to use. There's no need for a special technician dedicated to printer operation and maintenance.

Engineers went from concept to fully functional prototype for this traffic signal that incorporates UV-resistant ASA material.

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This prototype smart-home switch with fine features was enabled by the 0.007-inch resolution on the Stratasys F123 Printers.

GrabCAD Print™ software makes the task of printing parts easy too. It's formatted similar to CAD software, which is familiar to designers and engineers. Once parts are designed, the engineer simply hits the "print" command to print the parts.

File sharing is also possible through GrabCAD Print, so members of a design or engineering workgroup can collaborate in the design process and share access to the 3D printer. Each printer is also Wi-Fi-ready, making the 3D print function as easy as 2D printing from an office computer. Or, if Wi-Fi is unavailable, files can be printed via USB or Ethernet cable.

Monitoring the progress of a print job is simple, thanks to the printer's built-in camera. Users can check the print status directly from their workstation with GrabCAD Print or through an app on their mobile device.

The Challenge: The Lack of Space

"We've considered using 3D printing for rapid prototyping but it has a reputation of being a slow process and needs a dedicated, separate space because of the noise and materials that are used. Our design and engineering office doesn't have any separate factory space to locate a 3D printer."

How We Make Things Fit

For fast printing speed, Stratasys F123 Printers include Fast Draft print mode, which operates at twice the speed of the standard FDM print operation while typically using only one-third the material. This lets you 3D print models very quickly, whether it's for faster part iterations to validate design concepts or to quickly print multiple concept models for management or customer buy-in.

This prototype carabiner design has a flexible living hinge made possible with Stratasys F123 Printer engineering plastics.

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The end cap on this stepper motor was 3D printed to perform functional tests for proper fit.

More importantly, these 3D printers are designed for the office environment. They use a clean build process with no hazardous chemicals or materials and operate using standard 110-volt office electrical power. 3D printed models are built in an enclosed, insulated build chamber with an auto-locking door for safe operation and no risk of outside physical interference. Noise insulation provides exceptionally quiet operation, under 46 decibels, which is similar to a residential refrigerator.

The Challenge: The Lack of Options

"Our 3D printer uses only one type of material but we'd like to develop prototypes using several different materials. Also, replacing empty material cartridges is cumbersome and time consuming."

How We Make Things Flexible

Designed with versatility in mind, the Stratasys F123 Printers are capable of printing with several materials, each one tailored to meet specific requirements.

PLA is an economical choice, providing the best option when you need fast model creation and/or need to print them in greater quantity. ASA, ABS and PC-ABS are engineering-grade thermoplastics that offer flexibility when models and prototypes need differentiation, such as UV light resistance or high strength and durability. These materials can also be printed in Fast Draft mode.

To make material changes and replacements much easier, Stratasys F123 Printers use self-positioning filament spools designed for the fastest replacement of any FDM 3D printer in the marketplace. Changing or replenishing material takes no more than a minute to remove and replace the empty spool and feed the filament into the bay drive. Spools are located in an easily accessed drawer at the front of the printer. When changing between different engineering plastics (non-PLA), there's also no calibration required nor any need to change printer head tips.

The Challenge: Too Much Downtime

"Our 3D printer isn't a very reliable system, resulting in more downtime than is reasonable, making it an unproductive investment."

How We Make Things Reliable

Stratasys F123 3D Printers offer the most reliable FDM capability in the market, fulfilling one of their primary design requirements. It starts with the deliberate decision to use industrial-quality components coupled with design best-practices from over 25 years of Stratasys FDM development. More importantly, over 100,000 hours of reliability testing was accomplished to prove out the design reliability performance of the Stratasys F123 Series.

Making It First

FDM 3D Printers create models and prototype parts directly from digital data, quickly, easily and locally, for concept verification, design validation and functional testing. That's a game-changing advantage in a competitive market where the winner is often decided by who gets to market first. It antiquates traditional methods of prototyping that rely on expensive and time-consuming modeling machining or injection molding.

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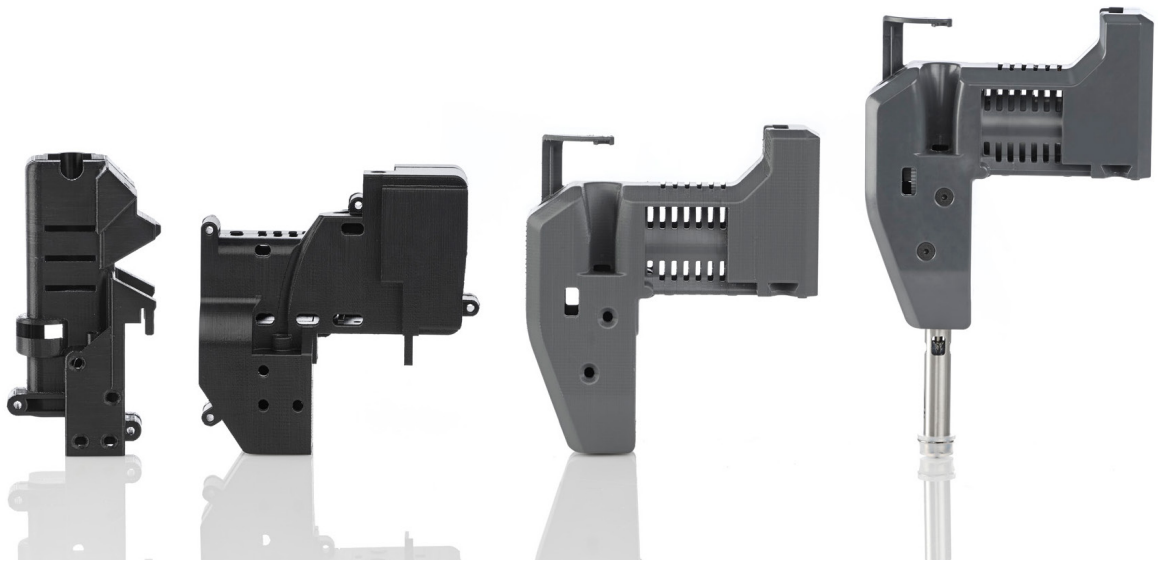

Stratasys F123 print head design iterations developed with FDM rapid prototyping technology.

As proof of this advantage, the Stratasys F123 3D Printer Series itself was developed using the same time- and cost-saving FDM technology and capabilities they are designed to offer: namely, faster concept validation and functional testing, resulting in a better product.

How We Made it Perfect

To provide faster print speeds and the capability for multiple materials, the Stratasys F123 Printers required a new print head design. Stratasys engineers created multiple versions of the head and 3D printed them. In total, over 20 design iterations were created and 80 head housings 3D printed during the design development and verification stage.

This seemingly repetitive process was necessary to refine the design to ensure accuracy and achieve a precise fit with mating parts. These parts were also used for functional testing, going beyond just concept and design validation, and were even used in some of the initial printer assembly prototypes. The capabilities of FDM thermoplastics provided the durability needed to mirror the engineering specifications required for the injection molded final head design.

To achieve this level of rigor in design qualification and testing without FDM technology would be exceptionally expensive and time consuming Stratasys estimates that injection-mold prototyping tools for the head unit would have cost approximately $10,000 each. Producing molds for 20 design prototypes would be exorbitantly expensive, not to mention the lengthy lead time required to produce them.

The ability to create multiple design iterations not only helped distill the best configuration for the print head quickly, it also gave engineers substantial data from which to derive statistically significant test results. Numerous design iterations help unmask potential flaws that less-rigorous methods may not detect until post-production, risking product callbacks and other quality problems.

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In total, engineers 3D printed over 1000 parts for 15 different components in the Stratasys F123 Series design verification phase.

Without the FDM process, these prototypes would have been made with formed sheet metal, CNC machining and injection molding, requiring substantial time and cost outlay for this level of design rigor. The capability to 3D print and test many different designs produced the best configuration to prove the reliability of the final product.

Additionally, all of this development took place within the security of Stratasys facilities. This minimized the risk of confidential intellectual property falling into the wrong hands, a possibility when prototyping is outsourced.

Making Things More Precise

Perhaps the best illustration of where FDM technology benefited Stratasys engineers was in the creation of the oven air duct. The beauty of additive manufacturing is that it frees designers from design-for-manufacturability constraints, allowing the creation of virtually any shape and configuration.

Achieving the goal of consistent, reliable build results from Stratasys F123 Printers required a tightly controlled temperature profile within the build chamber. To do this, Stratasys engineers needed to create an air duct with the optimal size and geometry for precise air management. Mathematical and thermal modeling gets you in a range of what is required, but it can't provide exact results. Trial and error through multiple 3D printed design iterations allowed Stratasys engineers to achieve the precise, organic duct configuration that enabled the correct temperature profile. It would have been very difficult, if not impossible, to obtain the desired results with traditional, non-FDM prototyping methods and materials.

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Making Supply Easier

FDM technology not only provides the tools that shrink the product development and improve the opportunity for design optimization. It also offers added insurance against supply chain risks. In the development of the Stratasys F123 Series, engineers relied on a supplier for several final-production parts for validation testing. The supplier wasn't able to meet the development timeline, which threatened a six-week delay. To avoid the setback, Stratasys engineers 3D printed equivalent parts using FDM technology and kept the unit production schedule on track.

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The soluble support capability of Stratasys F123 Printers made it possible to prototype this camera lens cover with an adjustable aperture.

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Making It Cost-Effective

Engineering departments humming with multiple, productivity-enhancing 3D printers might seem like the next logical evolution of the design office as 3D printing becomes more accessible. This is especially true as the technology continues to mature and more low-cost, consumer-level 3D printers enter the market.

Consumer 3D printers may seem like an attractive RP solution because they're often compact and very affordable. They offer a low barrier of entry to inexpensive, in-house rapid prototyping capability and intellectual property security. While it's an appealing strategy, it's not without risk. Yielding to the seduction of low-priced equipment will often limit your long-term prototyping capabilities, growth plans and day-to-day equipment uptime.

In contrast, professional 3D printers like the Stratasys F123 Series provide additional value that justifies the investment, through increased capability, efficiency and reliability, illustrated by the following features and attributes.

Making Complex Projects Simple

Certain geometries can't be 3D printed without material that supports overhanging features and nested assemblies during the build process. Most consumer desktop printers lack support material capabilities for complex geometries like internal cavities and interlocking parts, which limits the design complexities that can be printed.

In contrast, the professional Stratasys F123 Series uses a unique and effective soluble support material, enabling more complex designs and fine details that include thinner walls and internal cavities, enabling unlimited design

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freedom. The hands-free removal process also saves labor, making the RP process more productive and efficient.

Make to Keep Its Cool

Controlling the temperature of the "oven", the enclosed build chamber of an FDM printer, is critical for maintaining design specifications as the part is built. Curl is an inherent behavior of plastic as it cools from a melted state and controlling this characteristic is essential to maintain part quality, particularly for long, flat parts. This is achieved with uniform airflow and complex temperature control throughout the build area.

Desktop printers don't have controlled build chambers. This limits the type of parts you can build as well as the consistency of obtaining quality results. Stratasys F123 3D Printers achieve tight temperature uniformity across the build plane, with no "dead spots", through a highly specialized design of electronics and temperature-control algorithms. This allows the creation of large, flat parts that can be printed in a variety of densities from sparse to solid fill modes without the risk of curling.

Made to Last Longer

3D printers used in workgroup settings usually experience high utilization, placing significant demands on the mechanical components. You don't want your workgroup's productivity hampered by poor printer reliability, resulting in frequent downtime. Stratasys F123 3D Printers are designed and built for high utilization, using durable components such as:

- Servo motors (vs. stepper motors) that are quieter and more robust for high-torque applications and dynamic load variations during printer operation, providing better control and more precise movement. Most low-priced desktop FDM printers use less expensive stepper motors, which typically produce a high-pitch whine making them bothersome in an office setting.
- Durable motion-control components like linear profiled rails with ball bearings (instead of sleeve bearings). They provide better repeatability and accuracy of the 3D printed part, smoother and quieter operation, greater load-carrying capability and maintenance-free operation. Many low-cost desktop printers don't use linear profiled rails, lowering the chance of repeatable part accuracy.

Making You More Productive

Stratasys F123 3D Printers offer multiple features that increase a workgroup's productivity. GrabCAD Print software enables print queue and multi-tray management, giving your team visibility to each member's print jobs, the ability to manage the print sequence and prioritize important jobs. The software also imports native CAD files, making it easier and faster to go from CAD model to print. Stratasys F123 user interface touch screens display in 10 languages, offering ease of use across global markets. The user interface on most desktop 3D printers has limited functionality and minimal language options.

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The Stratasys F123 3D Printer touch screen with multi-language display.

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Made by the Name You Can Trust

There's value in establishing your rapid prototyping infrastructure on proven technology, produced by a company with market tenure. 3D printer manufacturers lacking this experience may be here today but gone tomorrow, cutting off access to spare parts, material and support. The Stratasys F123 Series is a professional 3D printing platform, based on over 25 years of Stratasys experience developing and supporting 3D printers, materials and customer solutions.

MAKE THE NEXT STEP

If you're in the business of designing and developing new products, the Stratasys F123 3D Printer Series offers the straightest path to a positive impact on your bottom line. These 3D printers enable your designers and engineers to move rapidly from design concept through part verification to functional prototype in a fraction of the time, compared with traditional prototyping methods. That gets your product to market faster and reduces post-production quality problems. It also increases your chances of beating the competition.

These 3D printers are designed for ease of use and shorter, streamlined workflows that give your team the capability, reliability and simplicity they need in an RP platform to iterate, refine and perfect designs. They can do that in an office environment with clean, safety-certified 3D printers that are the quietest on the market, using three engineering-grade plastics, plus the economical choice of PLA.

This solution is not only for companies new to 3D printing but for long-time practitioners of the technology. That's because Stratasys F123 3D Printers maximize yield through reliable performance and simplified workflow, beyond what's currently available in professional or consumer 3D printers.

Stratasys F123 3D Printers leverage the time-tested durability and success of Stratasys FDM technology to offer the highest level of reliability out-of-the-box. Over 100,000 hours of testing support that assertion.

How would your company benefit if you could cut your product development time in half, or by an even greater percentage, compared with how long it takes today? How much more efficient would your design and engineering workgroups be with accessible, reliable 3D printers and a simple CAD-to-print workflow? With Stratasys F123 3D Printers, there's never been a better opportunity to take advantage of FDM technology to improve your business operation.

A Stratasys F123 Series 3D Printer is designed to be a team player, for the way you work. Learn more at Stratasys.com or contact a Stratasys representative, and take the next step to smarter prototyping.

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