WHITE PAPER

Outsourcing vs. In-House: When Does it Make Sense to Bring SLS 3D Printing In-House?

In this whitepaper, we evaluate the value proposition of bringing selective laser sintering (SLS) 3D printers in-house, in comparison with outsourcing SLS parts from a service bureau. While SLS 3D printing is one of the most popular additive manufacturing processes, SLS printers are currently installed in businesses at lower numbers than other technologies due to their traditionally large size, complexity, and high price. With the introduction of the economically sized and priced Fuse Series, Formlabs has changed the landscape and allowed for manufacturers to bring SLS technology in-house, empowering businesses to reduce their costs and reliance on external suppliers. By providing an overview of the SLS 3D printing market today and conducting six case studies representing three applications, we will demonstrate the positive ROI of bringing SLS in-house for all different types of businesses.

July 2022 | formlabs.com

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An in-house SLS production facility with Formlabs Fuse Series SLS printers.

Abstract

A 2021 report by service bureau Sculpteo revealed that over 75% of manufacturers are currently using selective laser sintering (SLS) technology for a wide variety of applications. The numbers point to the fact that manufacturers are not early adopters when it comes to powder based 3D printing, but rather the overwhelming majority. With so many companies already relying on SLS parts at different stages in their product development and manufacturing process, the question is not if or how SLS printers will be used, but if it makes budgetary sense to bring them in-house rather than order parts from an external service provider.

Bringing an SLS 3D printer in-house is therefore not about adopting a new technology—it's a way to take more control over your means of prototyping and production, and save money and time utilizing a technology that is already familiar to the organization. While SLS 3D printing used to be overly expensive and complex, the business case and positive ROI was made drastically more feasible with the arrival of the Fuse Series 3D printers—the first SLS 3D printers that can deliver industrial quality parts at an affordable price and with an accessible footprint.

In this white paper, we look at the differences between outsourcing and in-house SLS 3D printing, and compare and evaluate the costs and lead times for three different applications—prototyping, end-use production runs, and manufacturing aids—using real-life example parts and scenarios.

Introduction

Selective laser sintering (SLS) refers to an additive manufacturing process in which a laser sinters one thin layer of powder on top of another, building a part vertically inside a build chamber. These 3D printers use plastic powder particles, but they are typically considered to be in the same family as other powder-bed fusion 3D printing systems, like multi-jet fusion (MJF) or metal laser sintering (DMLS or SLM) printers. The manner in which the parts are built offers several advantages.

First, the powder bed surrounds the parts during the print process, eliminating the need for support structures and enabling complex geometries like interlocking links, functional assemblies, and living hinges.

Another advantage is the materials themselves—SLS 3D printers can create strong, durable, temperature-resistant, and long-lasting parts for functional testing of prototypes or for end use applications. SLS 3D printing materials, such as nylon, are already heavily used in the design, engineering, and manufacturing communities, whether through an injection molding process or additively manufactured.

Besides the advantages of producing parts with complex geometries and advanced material properties, bringing SLS in-house means businesses can control a greater portion of their manufacturing processes. The Fuse Series printers are intuitively designed, have an accessible workflow, and a compact footprint, allowing businesses to integrate them into existing systems seamlessly. The Fuse Sift post-processing unit takes complexity out of the post-processing stage, and the multi-build chamber workflow allows for continuous production, all with minimal labor.

Traditional SLS 3D Printing

Traditional industrial SLS 3D printers have been the only 3D printing option for parts meant to replace or simulate injection molded plastics, but utilizing them in-house has been out of reach for most manufacturers. Historically the only SLS printers available were complicated to use, required special infrastructure, including HVAC and industrial power, and were prohibitively expensive, with a starting price of around $200,000, and well beyond that for complete solutions.

As 3D printing has become more widely used, the demand for SLS parts has grown exponentially. As reported in the Formlabs 2022 3D Printing Applications Report, 46% of respondents shared that SLS technology was the most important in terms of perceived future impact on their business, the highest out of the three main plastic 3D printing technologies.

SLS 3D Printing Through Service Bureaus. The Only Way?

Service bureaus and contract manufacturers have begun to answer the demand for high strength, lightweight, durable parts by offering SLS as an option. Though most businesses couldn't afford a machine themselves, they could afford to pay a couple hundred dollars for a part, especially when comparing that price to the many thousands of dollars they would spend on making a mold for an injected molded version. Similarly, most companies weren't able to accommodate the machines in their facilities, but the service bureaus and contractors had ample space and the expertise to operate these machines.

Part providers however, are dealing with hundreds, if not thousands, of part requests, and need to ship the parts. Depending on the order size and volume, the lead time to get a print back might take weeks, and if there is a consultation required, the process can extend far beyond that. For the requestors, who aren't familiar with SLS design guidelines, they might require changes to the design, and that back-and-forth between designer and an external contractor via phone, email, or video, can further extend the timeline. The same design iterations can be done quickly in-house when the designer and technician both have access to and knowledge of the printing optimization.

At the end of the day, costs and lead times add up, chipping away at the benefits of why businesses would choose SLS 3D printing in the first place. The math stops making sense, and so manufacturers use SLS for fewer applications, missing out on its full potential.

Applications of SLS 3D Printing

The high demand for SLS parts from service bureaus is in part due to the growing range of applications for which SLS is the ideal technology. Bringing the capacity to meet that demand in-house allows manufacturers to differentiate themselves from their competitors, by being able to iterate more extensively, become more resilient in the face of supply chain disruptions, or respond with more agility to the need for replacement parts and repairs.

Rapid Prototyping

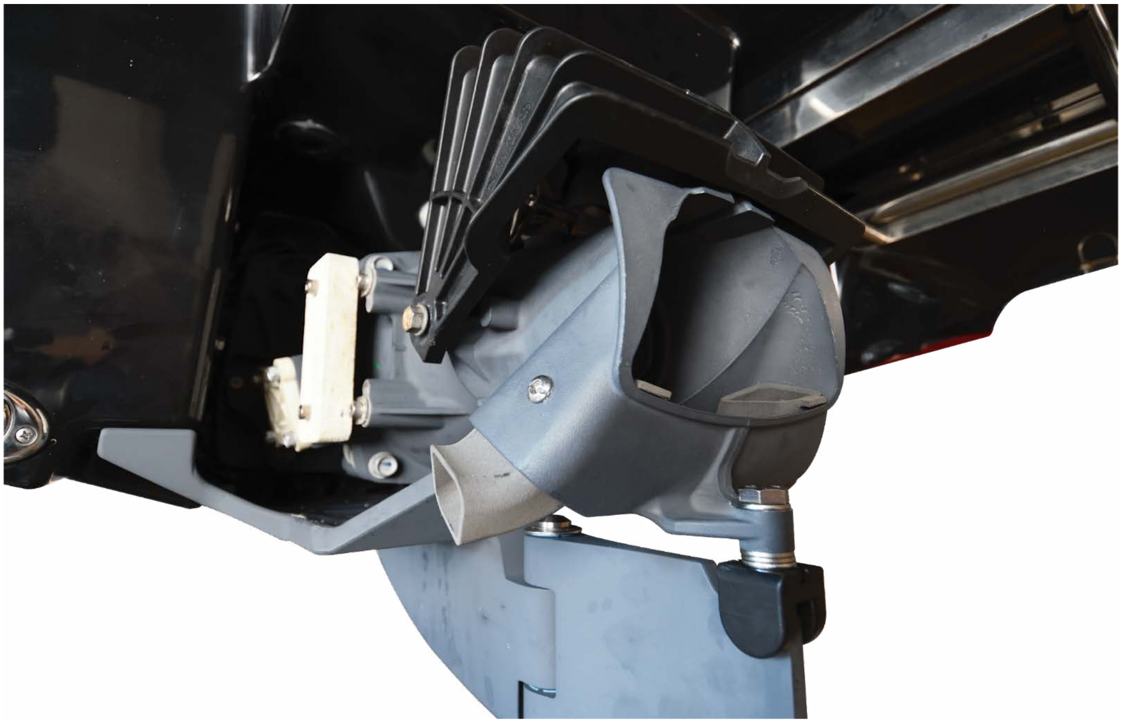
The most common use of 3D printing technologies is in the prototyping phase. Rapid prototyping, however, becomes much less rapid when the end user, designer, engineer, and technician are all in separate locations. Even if four different iterations are sent to a service bureau at the same time, it could still take a week or more to receive those parts back and begin testing them or getting internal feedback. That week of down time is eliminated by bringing SLS in-house. Having a Fuse Series SLS printer centralizes the process—truly rapid prototyping is done best by in-house teams that are able to collaborate on design, testing, and implementation.

The flexibility and strength of Nylon 12 make it ideal for functional testing of complex assemblies like multi-component snowboard bindings. Photo courtesy of Rome Snowboards.

For a customer like [Rome Snowboards,] who create between four and five new snowboard binding designs each year, the ability to prototype a new design with SLS parts and use them in their intended environment is crucial for technical improvements and their iterative process. The bindings will eventually be made through an injection molding process for each component, but because each design goes through tens of iterations, creating molds for each isn't possible financially, or in regards to lead times. Utilizing an in-house SLS 3D printer, the Rome design team is able to print an iteration and test it the next day on the mountain. This type of functional prototyping speeds up their design process and reduces costs while enabling greater design freedom and higher performance end products.

End-Use Parts

Though traditional methods of production are still most efficient in many cases, there are a few situations in which it makes sense to produce end-use parts with SLS 3D printers. In those situations, manufacturers gain a competitive advantage by producing in-house as opposed to going through a contractor or service bureau.



JetBoat Pilot engine thrusters (light grey parts in engine aperture), printed on the Fuse 1.

In aftermarket production, manufacturers have to respond to changes enacted by the OEM, a business model that requires agility and responsiveness in the design, testing, and production phases. For JetBoat Pilot, an aftermarket manufacturer of boat engine components, bringing a Fuse 1 in-house meant that he could create strong parts on-demand in response to the new engine model releases by the OEM. Previously relying on a service bureau drove costs and lead times up, but by bringing production in-house, JetBoat Pilot can produce tens of units each week as dictated by demand, and even reprint older models as replacements without having to store large inventory.

In-house SLS part production became globally relevant as supply chain issues effectively halted traditional methods of manufacturing beginning in 2021. With customers facing months of product delays, the manufacturers that were able to find a stop-gap solution gained a competitive advantage. Those that had SLS capabilities in-house were able to dynamically respond to shortages and pivot to focus their 3D printing capacity on parts that otherwise would be traditionally tooled. Because of the simple workflow and high material efficiency of the Fuse Series printers, manufacturers could keep production costs low and deliver products to customers at a time when competitors were at a loss, waiting for parts to arrive.

In-house production capabilities help businesses to insulate their supply chain and avoid long lead times from contractors. The part pictured above, printed in Nylon 12 on the Fuse 1 SLS printer, was [printed on early Fuse 1 models](#) for use in the manufacturing of production-ready Fuse 1 printers.

Depending on the application and the part design, SLS 3D printing can make financial sense for production runs up to 1000 or even 10,000 parts, which includes many scenarios, like short run production, supply chain stopgaps, aftermarket or spare parts, and bridge manufacturing. Our recent [SLS 3D Printing vs. Injection Molding white paper](#) explains the cost dynamics of several scenarios, using real life examples and pricing data for the two manufacturing methods.

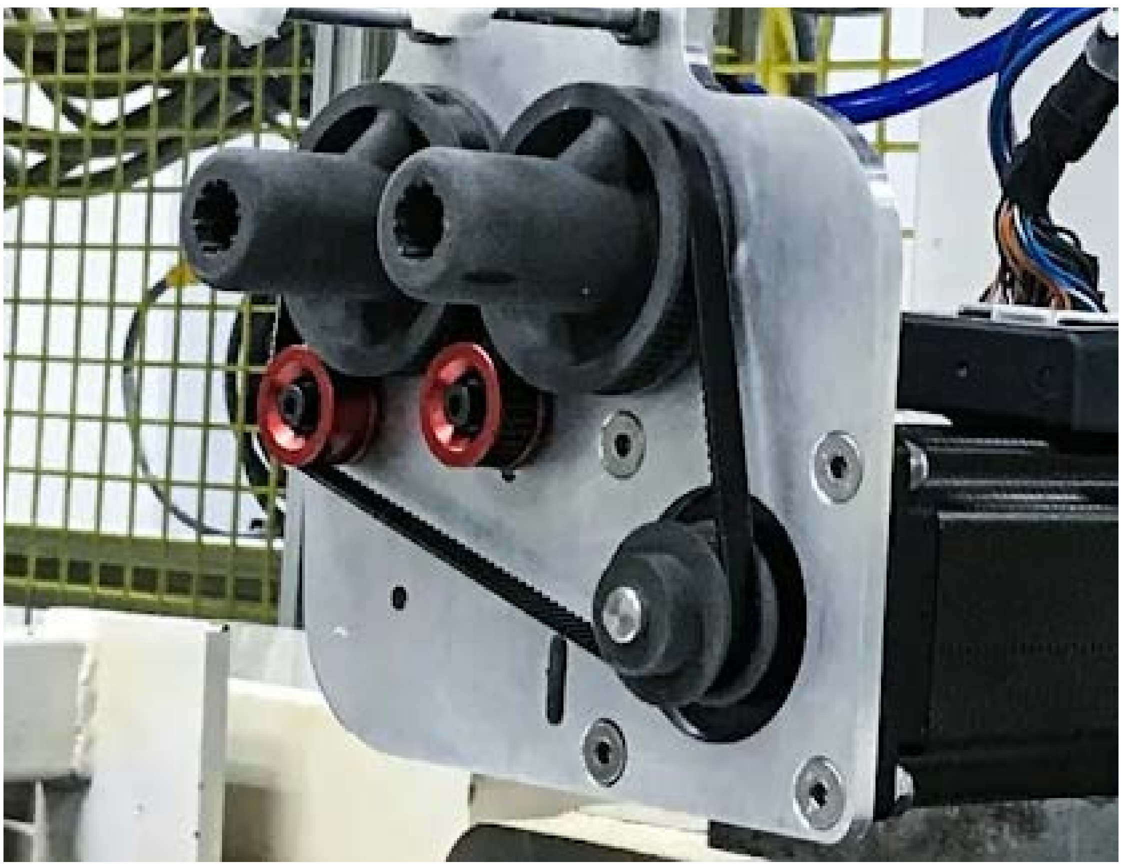
For start-up companies that don't have the funds to pivot back and forth between injection molding and 3D printing, utilizing the same methods of production as they already use for prototyping in-house is a great way to introduce a product and establish a revenue stream. By 3D printing their product in-house, the start-up can enter the market, gain customer feedback, collect revenue, and invest it back into their R&D or manufacturing, perhaps later switching to injection molding when the demand is readily apparent.

The Tension Square, a medical device prototyped and produced en masse on the Fuse 1 in Nylon 11 Powder.

Manufacturing Aids, Rapid Tooling, and Replacement Parts

Bringing SLS capacity in-house is never more relevant than when printing replacement parts for other machines. More and more businesses are creating a digital repository of possible 3D printed replacement parts for pieces of manufacturing equipment. If a machine needs a spare part, being able to 3D print it on demand saves days of lead time waiting for a part to arrive from the OEM or a service bureau. Every hour of down time for a machine can mean a loss in profit, and if that loss can be minimized by a quick SLS print from an in-house team, the business can mitigate losses.

For Formlabs customer Tessy Plastics, an injection molding contract manufacturer, the Fuse 1 enables the creation of on-demand manufacturing aids that save them time and ensure customer satisfaction. During the prototyping phase of one mold order, Tessy's customer substantially changed their design. Starting over again would have added weeks to the timeline, but Tessy's additive manufacturing manager was able to print a pulley system on the Fuse 1 that bridged the gap between the two designs from the customer. The mold worked as intended, and the customer order was fulfilled on time for thousands of parts.



Tessy was able to print the pulley system shown above to accommodate both the original mold design and the changes requested by the customer, and stay on track for delivery timelines.

Manufacturing aids have typically been very expensive tools made through subtractive processes, often out of metal. It's no surprise that 3D printing is providing a faster, more efficient alternative, but is there a need for in-house production of these tools? The advantage to fabricating your own tooling as compared to ordering from a service bureau lies in your ability to make changes and customize.

Tooling is often bulky, like the shaping presses, below, used by Swiss eyewear manufacturer Marcus Marienfeld. Marienfeld uses the Fuse 1 to create presses for bending titanium eyewear frames into a distinct shape. To order this press from a service provider, at higher cost and lead time would limit the number of different presses, and thus eyewear shapes, possible. Marienfeld has the ability to create multiple tools in one build chamber, and then press hundreds of different frames in a day, delivering the final titanium product in half the time it would have taken to rely on a service bureau.

A manufacturing tool printed on the Fuse 1 SLS 3D printer in Nylon 11 Powder for custom eyewear frame pressing.

The Fuse Series Brings SLS Within Reach

With an affordable price point, and a small footprint that enables everyone from small studio designers to large corporate manufacturers to install a printer, the Fuse 1+ 30W enables industrial quality SLS 3D printing in-house, lowering per part costs for every application and speeding up production.

The Fuse 1+ 30W and Fuse Sift put SLS within reach for small and medium manufacturers to get started, and large manufacturers to scale production.

Ease of Adoption

Since the introduction of the Fuse 1 in 2020, Formlabs has sold more SLS 3D printers than any other 3D printer manufacturer. Businesses are able to get started so easily because the price is affordable, the compact size and low weight means that the printer is easily installed, and the user experience is streamlined through the accompanying Fuse Sift all-in-one powder recovery station. Now with the upgraded Fuse 1+ 30W system, users can accomplish ROI even faster, with print speeds up to two times faster, enabling truly rapid prototyping and low volume production.

Businesses can allocate funds for a Fuse 1+ 30W system as well as materials, service, and training, at a fraction of the price of traditional industrial SLS systems. There is no need to hire and pay a dedicated technician—anyone who has used 3D printers in the past will easily be able to get started with the Fuse 1+ 30W's simple user interface and workflow. The price of the Fuse 1+ 30W opens the doors for small manufacturers that couldn't previously afford in-house industrial equipment. They can scale up production, increase their prototyping iteration rate, and improve their product lines without paying service bureaus for each part.

Low Cost and High Throughput

With a starting price below $40,000 for the full system, the entry price point of the Fuse 1+ 30W is 5-10x lower than that of traditional industrial SLS systems. This means that cost analyses need to factor in a smaller fixed cost, enabling manufacturers with lower budgets to bring SLS in-house. They can then reach positive ROI faster and for a wider range of applications. Thanks to the lower cost, per-part costs are dramatically reduced, making lower-volume production more viable.

The Fuse 1+ 30W and Fuse Sift workflow is a streamlined process easily managed by a single employee.

Curious to see how much you can save? [Try our interactive ROI tool]to calculate your time and cost savings when 3D printing on a Fuse 1+ 30W.

The Fuse Sift and modular build chamber workflow allow build chambers to be run and post-processed continuously, facilitating a higher volume of parts without any down time. One of the biggest contributors to lower per part costs is the powder refresh rate and improved packing density algorithm—which together create an optimal ratio of sintered powder to unsintered powder, improving the efficiency of powder usage and utilizing all the material in a more circular system. Thanks to the 30% refresh rate for the most commonly used materials, many Fuse 1+ 30W users are able to print with zero powder waste through optimized powder refresh rate and packing density. These users are able to use all of their non-sintered powder in their next print, eliminating powder waste and increasing the utility of each powder purchase.

Testing the Theory: Fuse 1+ 30W In-House vs. Outsourcing SLS Parts

To test the theory that in-house SLS is both faster and less expensive than ordering parts from a service bureau, we'll cover six case studies. Six different builds, representing three applications—prototyping, end-use part production, and manufacturing aids—will be printed on Fuse 1+ 30W printers in-house and sent out to the four leading US service bureaus. Both per part costs (including labor, materials, and shipping) and lead time will be measured and compared.

The "Total Time" of Fuse 1+ 30W in-house builds will be calculated by adding the print time, cooling time, and labor time for post-processing the parts in the Fuse Sift. The "Total Time" for Service Bureau SLS parts will be calculated by taking an average of the delivery time from the service bureaus, from uploading the file and placing an order, to receiving the parts at our location.

The "Total Cost" of Fuse 1+ 30W in-house builds will be calculated by adding the materials cost and labor cost, assuming a $17 hourly rate for the in-house printing staff. The "Total Cost" for service bureau SLS parts will be calculated by taking an average of the quoted costs for each build and standard shipping from the four service bureaus.

Application 1: Prototyping

Practice makes perfect, and in product development, practice is rapid prototyping. The ability to design, make small changes, print, and test a physical model leads to true innovation and measured improvement. 3D printing has opened the doors to rapid prototyping across every industry, and SLS 3D printing even more so, with works-like prototypes made out of functional, strong materials. However, companies are still deciding between rapid prototyping in-house, and functional prototyping through outsourcing. We'll take two prototypes, one for the automotive industry, and one for a consumer product (construction hardware), and see whether the cost and speed of prototyping are comparable with SLS in-house and outsourced.

Each build has been optimized to fit as many models as possible—this exemplifies the iterative process. A design team may think of several different changes to make to a part, and want to try each out for functional testing and visual experience. Packing a build chamber as efficiently as possible gives them the ability to test multiple prototypes, use their powder more efficiently and cost effectively, without extending their wait time by too much.

Prototype 1: Automotive Manifold

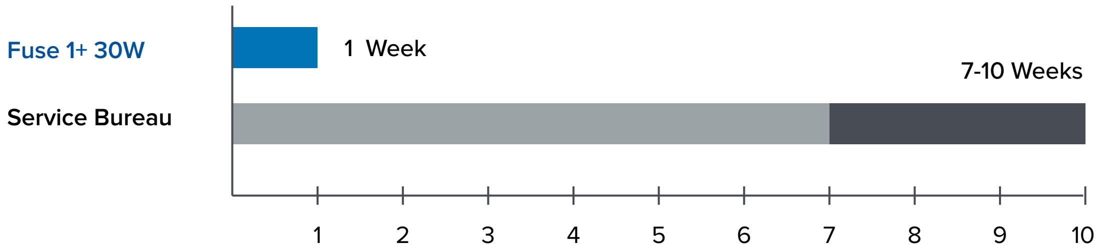
Material: Nylon 12

Build: Five parts

	FUSE 1+ 30W In-House	Service Bureau SLS
Print Time	15h 20m	
Cooling	14h 35m	
Sift Time (labor time for post-processing)	50m	
Total Time	**30h 45m**	7-10 business days
Materials Cost	$31.00	
Labor Cost	$14.11	
Total Cost	**$45.11**	$592.20
Cost Per Part	**$9.02**	$119.04

The prototype manifold, printed on an in-house Fuse 1+ 30W printer (left), and ordered from a service bureau with an MJF (HP) printer (center), and an SLS (EOS) printer (right).

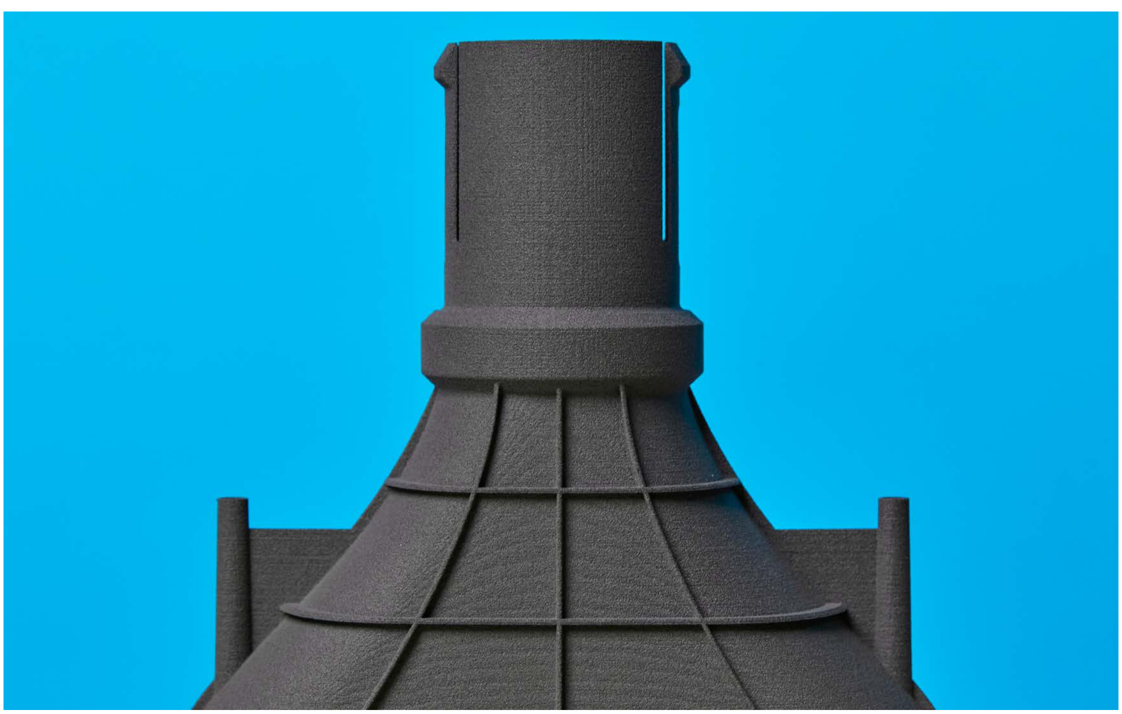
Prototyping Five Consecutive Round of Iterations



Expanding on this use case, if a designer wanted to iterate each day, with the Fuse 1+ 30W, they could start a print in the morning, take the first chamber out of the printer the next morning to let it finish its cooling cycle, and insert a second build chamber to start printing the next round of iterations. Each build would finish cooling in the afternoon of the next working day (29 hours and 55 minutes after it had begun printing), allowing the user to complete the post-processing in that same afternoon.

This means a team could create a full build on each working day (when running the printer also during the weekend), creating five full rounds of prototyping each working week. A product designer could produce 25 new iterations in-house within a working week and quite possibly finalize the design, at less than 10% of the cost and before they'd be able to receive even one set of iterations from a service bureau.

The savings created each round (of five parts each) by printing in-house are $547, meaning that a $44,000 Fuse 1+ 30W printer purchase (full system, including Fuse Sift, a service plan, and two build chambers) would be paid off in 79 rounds, achievable in just under four months.



The prototype manifold, printed on an in-house Fuse 1+ 30W printer.

Prototype 2: Power Drill Casing

Material: Nylon 12

Build: Two parts for each assembly, four total parts

	FUSE 1+ 30W In-House	Service Bureau SLS
Print Time	13h 10m	
Cooling	13h 45m	
Sift Time (labor time for post-processing)	40 minutes	
Total Time	**27h 35m**	7-10 business days
Materials Cost	$50	
Labor Cost	$11.22	
Total Cost	**$61.22**	$752.50
Cost Per Part	**$15.31**	$188.13

The prototype drill, printed on an in-house Fuse 1+ 30W printer (left), and ordered from a service bureau with an MJF (HP) printer (center), and an SLS (EOS) printer (right).

As with the first example, the total time required to produce these prototypes would allow in-house SLS users to run five full production runs each week, printing ten iterations of the two-part drill casing assembly. Compared to a single iteration every two weeks when outsourcing, an in-house SLS printer opens up opportunities for true iteration. Each new model could have a different aesthetic, alternatives for the grip's design, or screw threads placed in different spots, and then be presented physically to an approval team the very next day.

The savings when compared to a service bureau are close to $700, which equals over 90% savings for each round, meaning a Fuse 1+ 30W user could achieve positive ROI in just over three months and a little over one year if it's used just once a week.

Application 2: End-Use Part Production

Once a design has been finalized and the consumer demand projected, production runs begin. For production runs, the typical question is not whether to SLS 3D print in-house vs. service bureau, but comparing 3D printing with other traditional manufacturing methods, such as injection molding.

As we explored in our white paper comparing SLS 3D printing to injection molding, there are several possible scenarios in which 3D printing makes sense for end-use production, including aftermarket parts, customization, supply chain stopgaps, and more. Cost per part and throughput are two of the most important factors when calculating ROI for different manufacturing methods. The Fuse 1+ 30W offers fast print speeds, interchangeable build chambers, a streamlined post-processing unit, and improved packing density that vastly improve the economics for end use production.

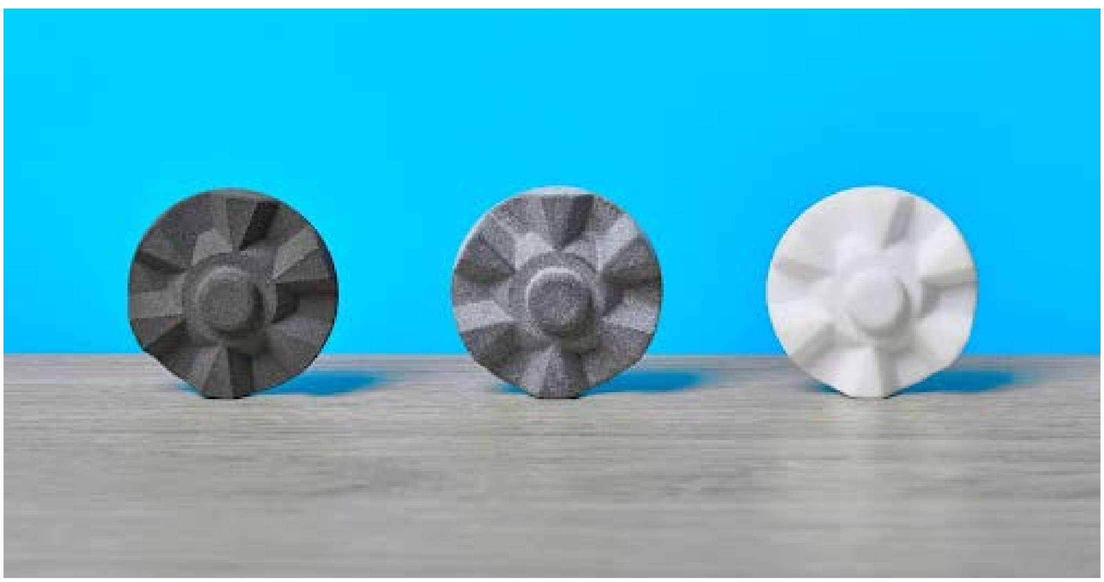
Now, we'll look at how much extra cost is added by a service bureau, and how that shipping time affects overall production timelines by comparing in-house Fuse 1+ 30W production runs with outsourcing SLS 3D printing to service providers. These production scenarios are designed to maximize throughput by utilizing the PreForm packing density algorithm to optimize powder usage and refresh rate, as well as deliver the most end-use parts to the user.

End-Use Production Run 1: Turntable Gear

Material: Nylon 12

Volume: 320 parts

	FUSE 1+ 30W In-House	Service Bureau SLS
Print Time	18h 26 min	
Cooling	13h 51m	
Sift Time (labor time for post-processing)	5h 20m	
Total Time	**37h 37m**	7-10 business days
Materials Cost	$115	
Labor Cost	$90.60	
Total Cost	**$205.60**	$2233.60
Cost Per Part	**$0.64**	$6.98



The turntable gear, printed on an in-house Fuse 1+ 30W printer (left), and ordered from a service bureau with an MJF (HP) printer (center), and an SLS (EOS) printer (right).

As shown in our whitepaper, the breakeven point for injection molding this turntable gear was at quantities close to 8,000 units when compared to SLS 3D printing on the Fuse 1. In a single build on the Fuse 1+ 30W, 320 parts can be printed for about $206. Utilizing multiple build chambers, a technician can start a print each day of the week and post-process builds the next day after the cooling period.

With this workflow, five full production builds can be completed each week for a total of 1600 parts produced weekly. An in-house Fuse 1+ 30W could produce 6400 parts each month, creating a reasonable alternative for production, when it often takes that time to create a new injection mold for traditional manufacturing. Due to the higher per part costs, outsourcing offers substantially worse economics, which means that the breakeven point for injection molding would be around 1500 parts—still respectable, but competitive for a much smaller range of applications.

The savings when compared to a service bureau are close to $200, which equals over 90% savings for each round, meaning a Fuse 1+ 30W user could achieve positive ROI in just over one month.

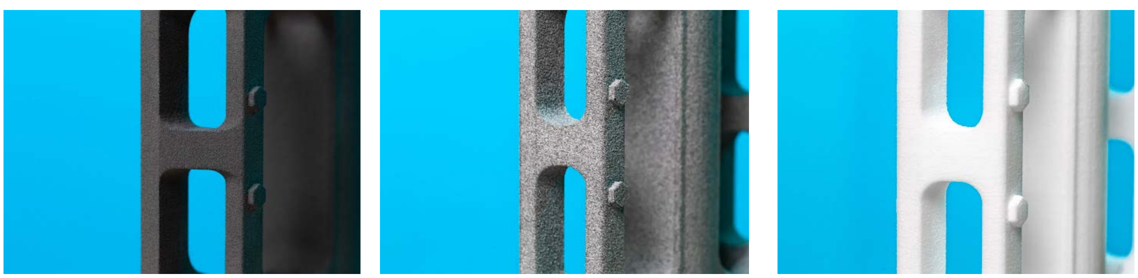
The turntable gear, printed on an in-house Fuse 1+ 30W printer.

End-Use Production Run 2: Bike Pedal

Material: Nylon 12

Volume: 36 parts

	FUSE 1+ 30W In-House	Service Bureau SLS
Print Time	23h 15m	
Cooling	13h 52m	
Sift Time (labor time for post-processing)	6h	
Total Time	**43h 7m**	7-10 business days
Materials Cost	$183	
Labor Cost	$51	
Total Cost	**$233**	$1431.36
Cost Per Part	**$6.47**	$39.76



Close-up comparison of the bike pedal, printed on an in-house Fuse 1+ 30W printer (left), and ordered from a service bureau with an MJF (HP) printer (center), and an SLS (EOS) printer (right).

The bike pedal production case study shows that 36 pedals can be produced in a 43 hour period, though a new print can be started each morning when utilizing multiple build chambers.

Starting a new build when the technician arrives each morning and post-processing it the next day allows for five rounds (180 parts) during a typical five day work week, and at minimum 720 parts a month. At $6.50 per part, compared to almost $40 per part when outsourcing, SLS 3D printing in-house can still be a competitive manufacturing option, while outsourced parts are so expensive that the 3D printed pedals would be practically priced out of the market.

Application 3: Manufacturing Aids, Rapid Tooling, Replacement Parts

Manufacturing aids and tooling can take a variety of forms—customized grippers that help automated machines pick and place products more efficiently, tooling that helps shape a final product into the proper geometry, or jigs and fixtures that support assembly or QA. Any production run requires a range of these tools that are inherently produced in low volumes and can often benefit from the strength and durability that SLS 3D printed parts offer.

Replacement parts have a similar demand pattern—they aren't needed in large quantities, but when a tool or repair part is needed and the assembly line remains stalled, speed and accuracy are of the utmost importance. For these applications, in-house SLS can be a faster and more cost-effective alternative to machined aluminum parts..

Our first example is a SLS printed tool used by Markus Marienfeld for shaping titanium eyewear frames. The geometry is customized and the manufacturer creates these based on different customer facial geometries. A collection of frames might cover multiple geometries, and custom tooling is necessary for each one. This type of customization in tooling would be impossible with expensive, traditional tooling creation, but with SLS 3D printing, it's much more feasible. This case study prints 21 different tooling shapes in one SLS build chamber, optimizing powder packing density and refresh rate.

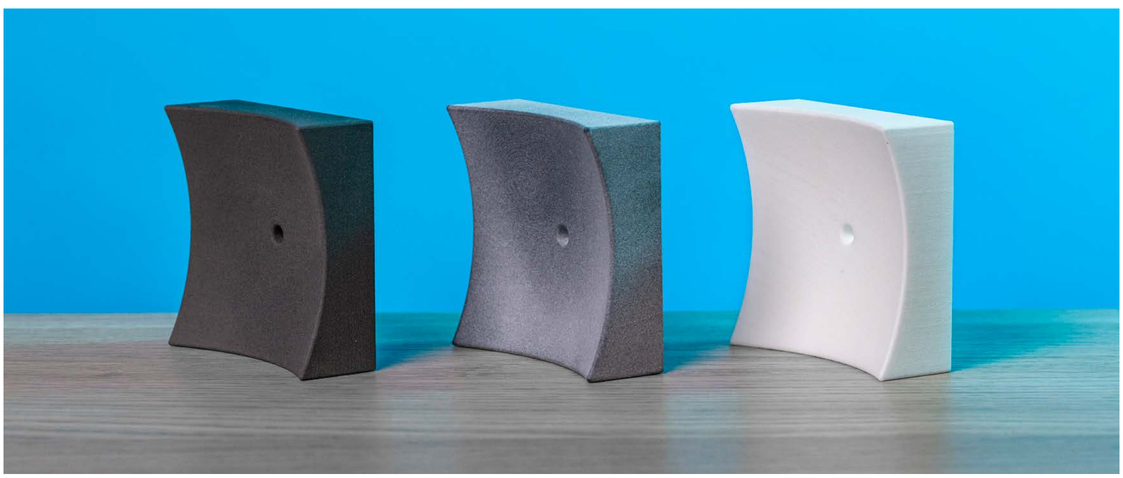
The second example is a crank handle replacement part—a sort of part that might break off during a manufacturing process and needs to be replaced in a rigid, strong material. Because these parts would only be printed on demand, the quantity is only one—despite printing small quantities being less optimal for powder packing and refresh rate utility.

Rapid Tooling: Titanium Eyewear Frame Forming Tooling

Material: Nylon 12

Volume: 21 parts

	FUSE 1+ 30W In-House	Service Bureau SLS
Print Time	21h 46m	
Cooling	13h 54m	
Sift Time (labor time for post-processing)	3h 30m	
Total Time	**39h 10m**	7-10 business days
Materials Cost	$252	
Labor Cost	$59.50	
Total Cost	**$311.50**	$1863.54
Cost Per Part	**$14.83**	$88.74



The titanium eyewear frame forming tooling, printed on an in-house Fuse 1+ 30W printer (left), and ordered from a service bureau with an MJF (HP) printer (center), and an SLS (EOS) printer (right).

Though the overall cost for 21 tooling parts was over $300, the per part cost is closer to $15. From the service bureau, the per part cost was $89. Before bringing the Fuse 1 in-house, the eyewear manufacturer would carry out the forming process using steel tools, which was both costly and time-consuming, and meant that customization was significantly more expensive. By forming eyewear frames on tools printed on the Fuse 1, Marienfeld can provide a better service to his customers and truly mass customize his products.

Replacement Part: Crank Handle

Material: Nylon 12

Volume: 1

	FUSE 1+ 30W In-House	Service Bureau SLS
Print Time	5h 37m	
Cooling	11h 20m	
Sift Time (labor time for post-processing)	5m	
Total Time	**16h 57m**	7-10 business days
Materials Cost	$3.00	
Labor Cost	$1.42	
Total Cost	**$4.42**	$47.72
Cost Per Part	**$4.42**	$47.72

The crank handle replacement part, printed on an in-house Fuse 1+ 30W printer (left), and ordered from a service bureau with an MJF (HP) printer (center), and an SLS (EOS) printer (right).

The ROI of an in-house SLS machine printing single replacement units is not easily shown by looking solely at the per part cost. Though about ten times less expensive than outsourcing to a service bureau, it would still take more than a thousand replacement parts to pay back the cost of the printer.

However, how much is it worth to your company to have a production line down for a day, versus up to two weeks? Obviously the answer differs case by case, but this shows how the efficacy of having an in-house SLS printer for replacement parts should instead be measured by how quickly replacement parts can get a machine back up and running. For every hour a machine is waiting for a repair part, the entire company is losing money. With an in-house machine, you can have a part by the next day and get the entire manufacturing process back up and running within 24 hours, which might be enough to pay for the price of the printer if it happens only once.

ROI With the Fuse 1+ 30W: Months, Not Years

In each prototyping, production run, and manufacturing aid case study, the cost of printing in-house when compared to outsourcing to a service bureau was significantly lower. This cost comparison assumes that the in-house SLS printer has already been purchased, and the cost of a printer is not being amortized into the cost of production.

However, since the initial cost of the system is what holds many businesses back from bringing production in-house, we'll take a look at how long it would take for the business to make a positive return on their investment.

	In-House Savings Per Build	Service Bureau SLS	Full Builds Possible Per Week	Time to ROI (rounded up to nearest week)
Prototyping 1: Automotive Manifold	$547.09	79	5	**16 weeks**
Prototyping 2: Power Drill Casing	$691.28	62	5	**13 weeks**
Production 1: Turntable Gear	$2028	21	5	**5 weeks**
Production 2: Bike Pedal	$1198.36	36	5	**8 weeks**
Rapid Tooling: Titanium Eyewear Frame Forming Tooling	$1552.04	31	5	**7 weeks**
Replacement Part: Crank Handle	$43.30	1,108	5	**N/A***

**The ROI calculation for an in-house Fuse Series printer is difficult when considering a replacement parts application. Replacement parts are impossible to predict, and indeed are preferably never needed. The real benefit of having an in-house Fuse Series printer for replacement parts becomes apparent when purchasing it for predictable, steady-demand applications and then having it readily available when, or if, a replacement part is necessary.*

These ROI estimates show that most companies that have a single application and enough demand for SLS printing to use a Fuse 1+ 30W to just 10% of its capacity would benefit from adding an SLS 3D printer in-house rather than outsource. And once a business has an SLS printer in-house, expanding to new applications comes with a lower barrier to entry than with outsourcing, encouraging innovation.

For most businesses that need to produce new products, the prototyping stage can be reduced by several months, and these results prove that having an SLS printer in-house can create a return on investment within just one product's prototyping process. Both the automotive manifold and the power drill use-cases show that prototyping in-house is often 10X faster and cheaper than outsourcing. Printing 60-80 different builds will accomplish a positive return on investment, which, for a company that develops products continuously, will happen in less than three-four months.

For the production runs, both the turntable gear and bike pedal show that cost per part is substantially lower when printing parts in-house. This is influenced by the small part size and efficiency of packing the parts into the chamber. Production use-cases of small parts make it very easy to accomplish optimal packing density. This leads to a zero-waste printing process, where every bit of unsintered material can be used in the next printing cycle, while still staying within the optimal ratio of recycled to fresh powder. For situations where hundreds, or even thousands of end-use parts are needed quickly (such as low volume production, supply chain disruption, or an impending deadline), using a Fuse 1+ 30W can provide a more cost-efficient in-house solution or an alternative if outsourcing or traditional methods will take too long.

For the first manufacturing aid application, a tool for forming eyewear frames into a particular shape, the return on investment is more in line with the prototyping and production run use cases—if there's enough demand for printing, the machine will be paid off in just a few months. Creating tooling like this is an easy, inexpensive way to increase access to customization. In this scenario, the user can print 21 different iterations of the tooling press, for 21 different face-shapes. The eyewear manufacturer can then offer eyewear frames for different frame shapes as well as different face shapes.

The notable exception to the quick ROI of prototyping and production runs is the replacement part use-case. As only one part is required, the cost savings are not significant. However, it's important to think about this particular scenario—a piece of equipment has broken and needs an immediate replacement. The broken component is actively halting production, which can have an impact on the bottom line for each minute it's non-functional. The options for finding replacement parts are:

- Order from the machine manufacturer
- Create tooling and mold/cast/machine another one
- Order a 3D printed part from a service bureau
- 3D print the part in-house

When time is of the essence, the option that gets a replacement part installed the fastest, and production running again, is 3D printing that part in-house.

Conclusion

SLS is an ideal way to prototype functional, strong, and industrial-quality parts quickly and inexpensively, and a complementary manufacturing technology for end-use parts.

For these scenarios, when SLS has already been ordained as the best method, the decision between outsourcing these parts or printing them in-house is clear—printing SLS parts in-house is faster and less expensive. Printing prototypes in-house was at least 10X less expensive than outsourcing, and delivered the parts the next working day, compared to 7-10 days of lead time from a service bureau. Though the advertised time when ordering the parts was at maximum five to seven days, because of the quantity ordered (one from each use case) as well as expected shipping delays, the actual time was well over a week.

Production runs were over seven times less expensive in-house, and delivered the parts four days earlier. With traditional methods of production, the idea that any new product can move from design to finished part-in-hand within days is unheard of. Traditional, non-3D printing alternatives still make sense for production with large enough and stable demand trends and years-ahead forecasting. In-house SLS is a viable alternative for any production with low or unpredictable volumes, whether that's aftermarket, stop-gap, new product, or replacement part manufacturing.

Manufacturing aids and tooling were about six times less expensive in-house, and delivered the parts mostly within 24 hours, which is enough to save the day when it comes to replacement parts.

When amortizing the cost of the initial printer purchase, the timelines for full return on investment were only a few months in most cases, and for the outlier (replacement parts), still a time-efficient option in comparison to traditional manufacturing methods. When considering that the average SLS printer in-house is primarily printing prototypes, low volume production runs, or tooling, replacement parts can be seen as an additional benefit, without factoring their ROI into the equation.

Fuse Series SLS printers and the Fuse Sift post-processing unit have made in-house SLS 3D printing accessible for the first time, enabling hundreds of manufacturers to create parts in only a few days, with the entire workflow under their control. The communication process between departments, from requestor, to design, engineering, technician, testing, and customer-facing teams can happen within a week, and every team can have the part in hand to discuss further alterations or implementation. Relying on an in-house SLS 3D printer puts control back into the hands of the manufacturer. The Fuse Series' accessible price point, intuitive workflow, and variety of industrial-quality materials makes it the ideal choice for those looking to reduce their reliance on third parties.

Determining the exact timeline for ROI can be complicated, taking into account various applications, materials, and production schedules. After working with hundreds of Fuse Series customers, our SLS expert team can help you plan a schedule for your specific parts, and determine how fast you can achieve an ROI on bringing SLS in-house.

Request a Free Sample Part

Speak With a Fuse 1 Specialist to Calculate Your ROI

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