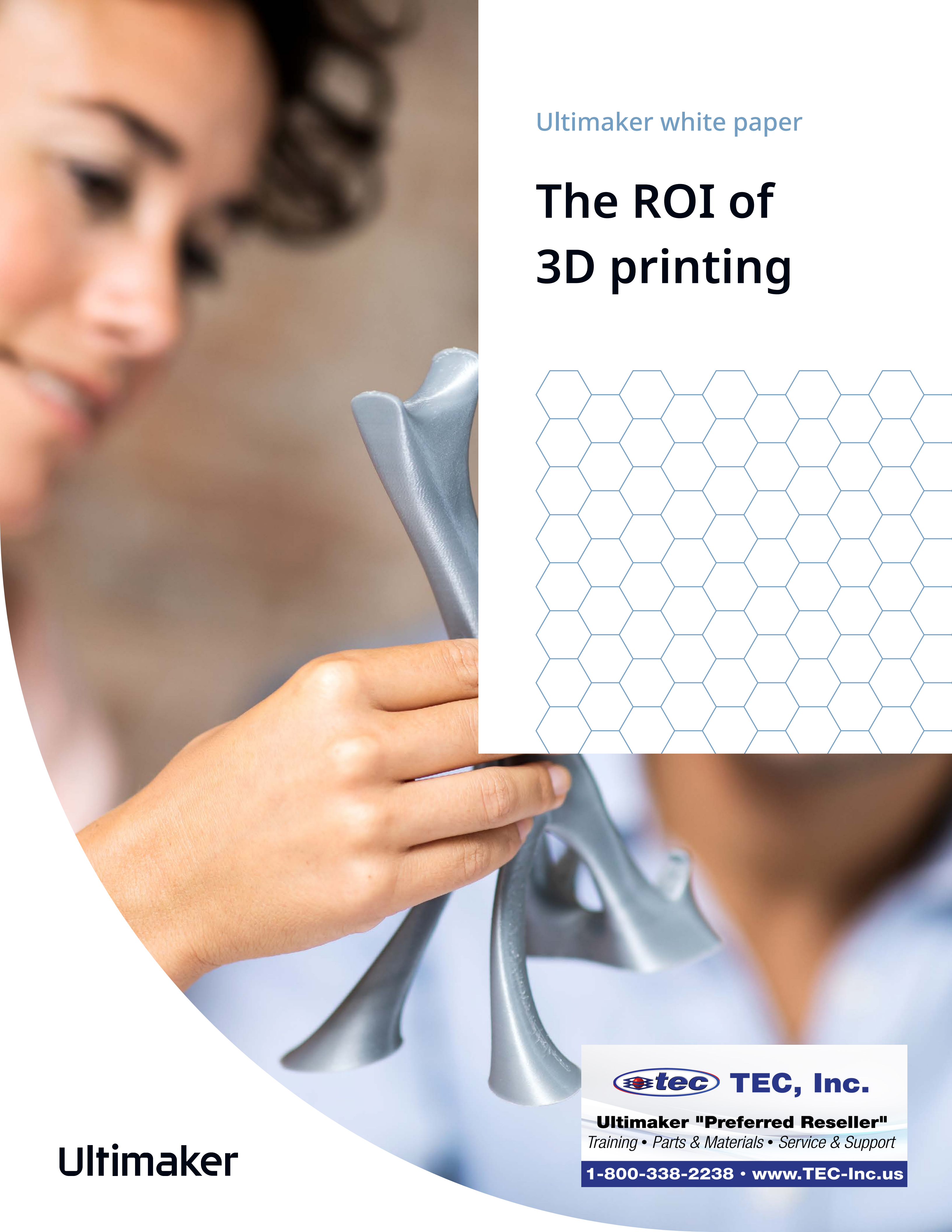
Ultimaker white paper

The ROI of 3D printing



Ultimaker

The ROI of 3D printing

Contents

EN 09/2019 v2.00 S3

Introduction

Desktop 3D printers are an attractive option for businesses because of their low purchase and running costs compared to other options. On the desk of a product designer, engineer, or manufacturer, a 3D printer is a powerful tool. It enables the fast and inexpensive production of visual models and functional prototypes, and on-demand production of highly customized manufacturing aids and end-use parts.

But before investing in 3D printing, it is important to calculate the costs involved and answer some key questions:

1. How does desktop 3D printing compare to your current costs?
2. How many 3D printers do you need?
3. How long will it take for savings to deliver a complete return on investment?

Choosing a high-quality, professional machine over a budget option creates significant savings through reliability and ease of use. A reliable 3D printer maximizes uptime and print success rate, while an easy-to-use printer reduces the time needed for operation, maintenance, and training.

This document outlines how to calculate the costs and potential savings of 3D printing, and provides a case study of one business that has achieved significant cost savings using desktop 3D printing.

Why invest in 3D printers?

Cost savings

Like any purchase decision, choosing whether to buy a 3D printer should be based on the potential return on investment (ROI). But it can be difficult to understand the potential savings if you aren't comparing similar costs.

For example, when outsourcing you pay a single price for the entire service. But with in-house 3D printing, you must account for factors such as labor and running costs. And before you purchase the printer, it isn't easy to know what those costs are. That's where this guide will help you.

Quality

Another consideration is how well desktop 3D printing actually performs as a prototyping or manufacturing solution. The main variables to look at are the available compatible materials and the quality of the parts they produce. Both factors vary dramatically depending on the 3D printer.

A propeller prototype 3D printed on an Ultimaker printer, next to the final production version

A high-quality 3D printer should be compatible with a wide range of materials, offering properties such as strength, flexibility, heat resistance, or chemical resistance.

But quality can be hard to measure.

Printer specifications can indicate quality, but we also recommend looking at customer case studies from 3D printer manufacturers. Are customers able to achieve the sort of results you require? If so, that's a 3D printer to consider investing in.

Availability

An in-house 3D printer is always available for on-demand production, creating a culture of continuous improvement as new ideas are tested and immediately implemented. Creating customized jigs, fixtures, or spare parts can reduce ordering costs in a manufacturing facility, while in-house production allows for a 'just in time' approach to your inventory, eliminating costly storage.

Efficiency

The key benefit of in-house 3D printing is the speed and efficiency it brings. For product designers, prototypes can be produced in a matter of hours instead of waiting for designs to be outsourced and delivered. This enables more iterations in a shorter space of time, resulting in cheaper product development, a more refined design, and a faster time to market.

Comparing costs: Outsourcing

If your business needs prototypes or highly customized parts, outsourcing may seem like a sensible option. And the lack of large, upfront investment means the costs are regular and predictable. But outsourcing has the disadvantages of high costs and long lead times when compared with in-house 3D printing.

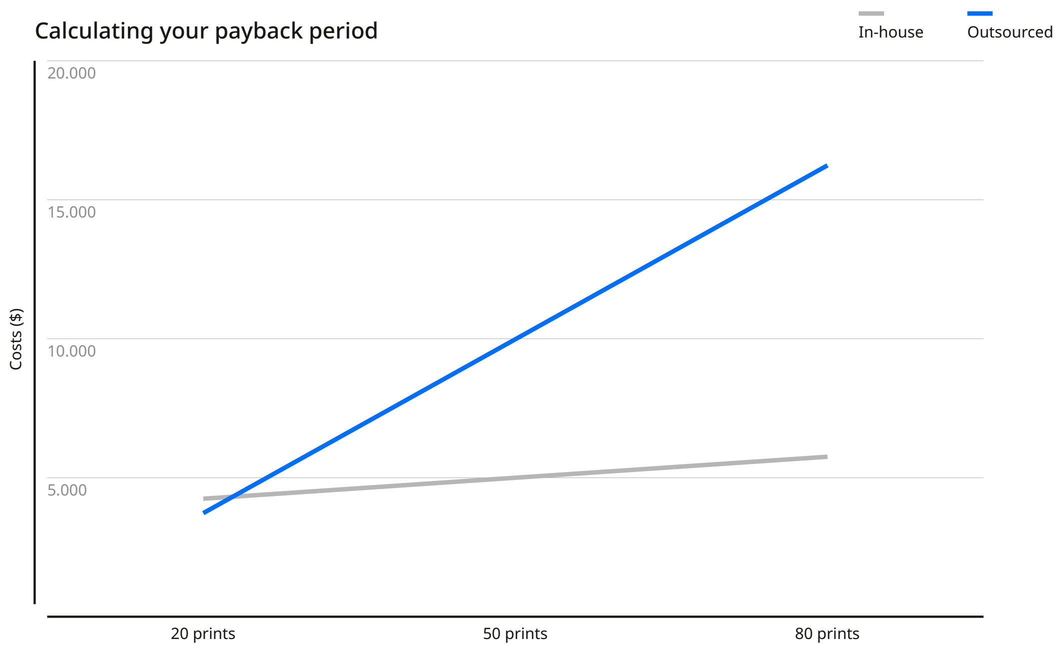
The initial investment in 3D printing may be higher, but can greatly increase capacity and throughput if efficiently managed. 3D printing is also completely scalable, so there is no penalty if you invest in one printer and realize it is not enough. You can simply purchase additional printers to meet your capacity needs.

A typical fused filament fabrication (FFF) 3D printer can complete one or two print jobs per day, based on the average requirements of a professional user. If you need to print more than 10 parts per week, you may need multiple printers for sufficient capacity. Your 3D printer provider will be able to advise you, based on the number and types of prints you need.

Calculating ROI

To calculate your 3D printing ROI and payback period, take a look at our quick and easy to use ROI Calculator. This handy tool calculates the return on investment that you could realize by switching to an in-house 3D printing solution, and provides a downloadable ROI report that you can use to gain stakeholder buy-in.

For illustrative purposes, we've used an Ultimaker S3 as an example and provided an ROI and payback period calculation below:



Examples are indicative, based on averages for in-house FFF and outsourced SLS 3D printing, with the hardware cost based on one Ultimaker S3 (including tax)

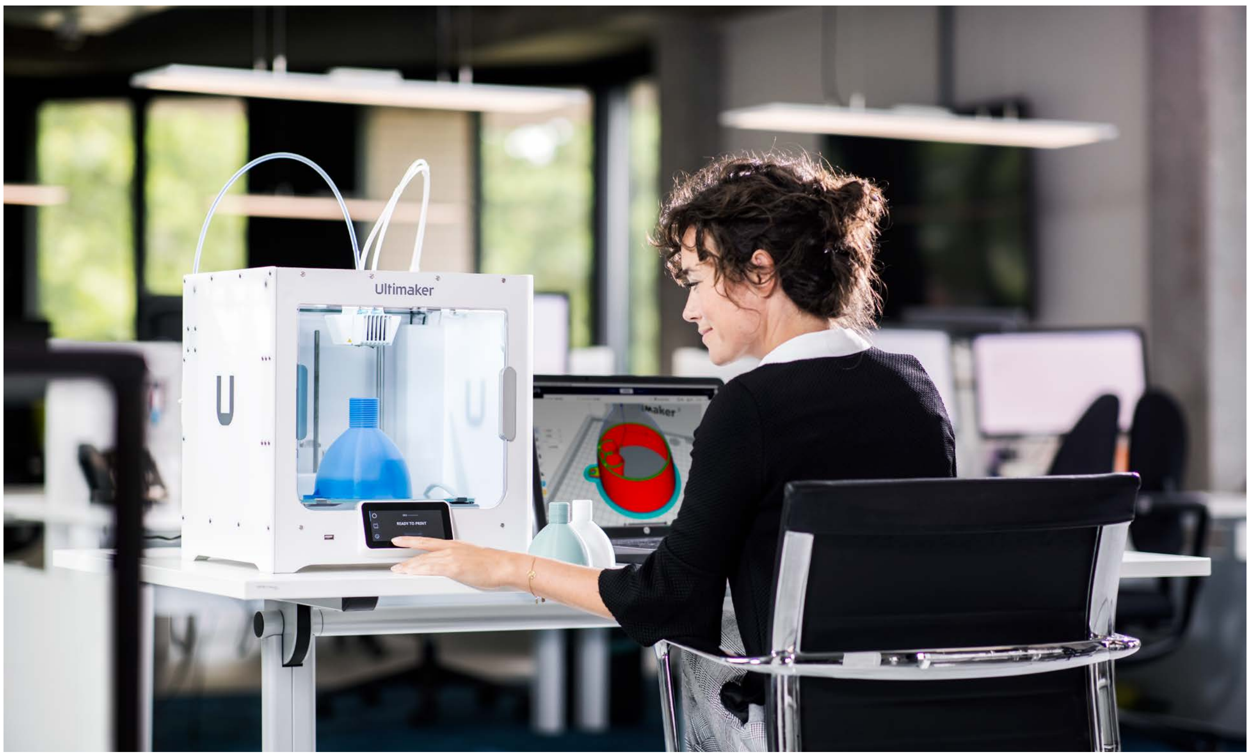
While your costs may differ from the examples used, this chart highlights the rapid ROI that 3D printing can offer. In this example, the payback period for the purchase of an Ultimaker S3 printer is after 23 prints. From this point, each 3D print provides a saving compared with outsourcing. So even though the upfront investment cost is higher, the cost per print is much lower. Here is a breakdown of the expenses:

Upfront costs	**In-house 3D printing**	**Outsourced 3D printing**
Investments in hardware and software	$3,850	$0
Training (optional)	$500	$0
Per-print costs		
Cost per print (estimate)	$10	$200
20 prints	$4,050	$4,000
50 prints	$4,350	$10,000
80 prints	$4,650	$16,000

A breakdown of 3D printing costs

Desktop FFF 3D printing is a particularly economical option when compared with technologies such as selective laser sintering (SLS) or large industrial 3D printers. For example, an Ultimaker S3 with no optional extras costs $3,850, excluding taxes. And Ultimaker Cura, the slicing software trusted by over 2 million users, is supplied free of charge.

Like an office printer that requires paper, FFF 3D printers require material, or filament. Ultimaker offers a wide range of materials designed to work optimally with our 3D printers, but our open filament system means that you can also use filaments from other material providers. On average, materials cost only a few cents per gram – approximately $5 to $20 per printed model.



Setup and maintenance costs vary, depending on the 3D printer's design. For instance, Ultimaker printers are designed with quick setup in mind, and maintenance tasks such as cleaning and calibration need only be performed monthly. Ultimaker printers are highly reliable machines, capable of running continuously with high uptime and print success rates.

Training

Even professional 3D printers should provide a relatively simple user experience, with 3D designs simply sent to the printer via slicing software such as Ultimaker Cura. So unlike a CNC machine, no specialized operator is required.

And for designers accustomed to using 3D modelling software, there is usually an easy and smooth transition to using 3D printing slicing software. User training requirements are therefore minimal, and in some cases unnecessary.

If your staff does need training, ask your reseller about the costs and content of any training they offer. You can also download our guides to FFF 3D printing and designing for 3D printing to help you get started.

Comparing costs: In-house processes

When moving to in-house production, there are several technologies to choose from. In this section, we examine the costs of five of the best-known in-house production methods:

1. Fused filament fabrication (FFF)
2. Stereolithography (SLA)
3. Selective laser sintering (SLS)
4. Computer numerical control (CNC)
5. Injection molding

Fused filament fabrication (FFF)

Thermoplastic or composite filament is extruded from the printer's nozzle and onto the build plate, forming an object layer by layer.

Cost considerations – pros:

- Affordable hardware
- Scalable due to affordability
- Wide variety of low-cost materials
- Minimal post-processing required

Cost considerations – cons:

- Manual post-processing sometimes required, e.g. removing supports
- Some manufacturers require that only proprietary materials are used

Stereolithography (SLA)

A vat of photopolymer resin is selectively cured by a laser, building an object layer by layer.

Cost considerations – pros:

- Affordable (desktop) hardware
- Scalable due to affordability

Cost considerations – cons:

- Materials more expensive than thermoplastics, with shorter shelf lives
- Multiple consumables – pigments, resin tanks, build platforms, and cleaning fluid need regular replacement
- Manual post-processing needed for every print
- Small build volume on desktop machines offers lower capacity

Selective laser sintering (SLS)

A laser fuses nylon or polyamide powder particles, forming a solid object layer by layer.

Cost considerations – pros:

- Cost effective if the build chamber is densely packed with parts
- Support material not necessary

Cost considerations – cons:

- Less economical when build chamber not densely packed.
- Waiting to fill the chamber can result in long lead times
- Hardware more expensive than FFF or SLA
- Requires more space than FFF or SLA
- Requires post-processing and powder-recycling stations

Computer numerical control (CNC)

Computer-controlled machining tools such as drills, bores, and lathes remove sections of a block of material.

Cost considerations – pros:

- Versatile, offering a variety of materials and finishes
- Efficient option when precision and repeatability required

Cost considerations – cons:

- High initial investment – CNC machines cost tens of thousands of dollars, or more
- Time consuming machine setup and axis reorientation
- Complex machinery requires training and a dedicated operator
- Subtractive process results in significant material wastage

Injection molding

Molten material is injected into a mold and solidifies in the required shape.

Cost considerations – pros:

- Highly automated process once initial setup complete
- Rapid production
- Cost effective for high-volume production

Cost considerations – cons:

- High capital investment
- High setup costs for each production run
- Expensive for low-volume production

Case study: Snow Business

Snow Business is the world leader in snow and winter effects for the film and TV industry, and for live events. The company uses Ultimaker 3D printers to create prototypes, functional test parts, and final parts for its intricate snow machine nozzles.

Challenge

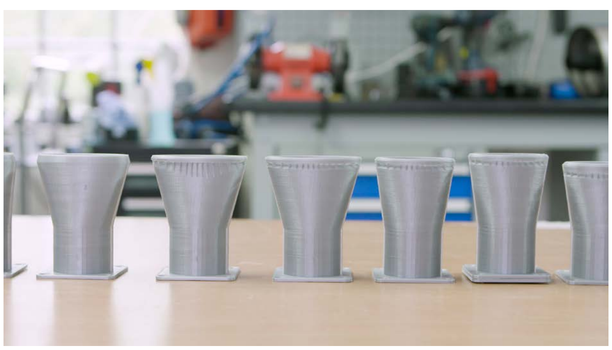
Previously, Snow Business outsourced the production of nozzle prototypes to SLS service bureaus, with a minimum order of $150. Turnaround times were anything up to seven days.

Solution

Snow Business invested in three Ultimaker 3D printers to prototype and produce nozzles for their snow machines. They can now cost effectively print nozzles in a matter of hours.

	SLS service	Ultimaker 3D printers
Cost per iteration	$150	$3.25
Lead time	7 days	7 hours

Paul Denney, Head of Research at Snow Business, estimates that the company's first printer paid for itself within just two weeks.



Iterations of the complex nozzle design (L) and the final 3D printed part in action (R)

How much can you save?

Calculate the return on investment that your business could achieve by introducing an in-house 3D printing solution from Ultimaker

Calculate your ROI

Request a quote

Representative

TEC, Inc.
www.TEC-Inc.us | 800-338-2238

About Ultimaker

Since 2011, Ultimaker has built an open and easy-to-use solution of 3D printers, software, and materials that enables professional designers and engineers to innovate every day. Today, Ultimaker is the market leader in desktop 3D printing. From offices in the Netherlands, New York, Boston, and Singapore – plus production facilities in Europe and the US – its global team of over 400 employees work together to accelerate the world's transition to local, digital manufacturing.

Ultimaker