Ultimaker white paper

The power of open:

How Ultimaker unlocks more 3D printing applications

Ultimaker

The power of open:

How Ultimaker unlocks more 3D printing applications

Table of contents

Ultimaker

1. Introduction

The world's leading businesses use 3D printing to speed up product development cycles and cut manufacturing costs.

The edge 3D printers give over more costly alternatives for rapid prototyping has been clear for decades. Print a design, evaluate the concept, iterate. For visual validation of your designs, using a 3D printer is an easy win.

But if you stop and look around your design studio or production line, you will probably see a lot more parts and products that you could be made with a 3D printer.

More materials, more applications

Material choice is one of the key considerations for an engineer when it comes to choosing a manufacturing method.

While there are many 3D printers on the market that only print with a handful of materials, with a flexible and open platform like Ultimaker, many more applications are possible.

A range of 12 optimized materials with a wide range of properties from strength to heat resistance and flexibility is a good start. But we believe in the power of being an open platform, so you can also use any third-party material of your choice on an Ultimaker 3D printer.

In this white paper, we set out some of the 3D printing applications that demand high-performance materials. Each chapter includes examples of real and practical 3D printing applications and a recommended Ultimaker-compatible material for the application. The white paper ends with step-by-step guidance on how to set up your 3D printing workflow to achieve these results.

With the complete, integrated, and open 3D printing platform offered by Ultimaker, you can simplify supply chains, achieve lean manufacturing best practices, and even improve the ergonomics and effectiveness of the parts you produce.

2. Tools, jigs, and fixtures

Tools, jigs, and fixtures are custom-made applications for the assembly or production line. Typically, manufacturing engineers design the tools they need and outsource these to be machined by a supplier, or perhaps made by an in-house service bureau.

The results? You get the tool you need, but with a number of drawbacks. High material costs, long lead times, and you have to store all the parts you ordered. And if an operator reports an ergonomic or quality issue with the tool, it could be weeks or months before an improved iteration is ready.

With a 3D printer on or near the production line, you can have parts on demand, for a fraction of the material costs, and can iterate as and when you need.

3D printed tooling enables just-in-time manufacturing, reducing storage costs

Quality assurance tools

Quality management is an essential part of any production line. It's a great place to take the first steps into 3D printing because the tools themselves are often simple in their designs.

Many devices that check for and prevent defects and errors can be 3D printed. For example, multipurpose measuring tools, shape or placement gauges, or mistake-proofing devices.

L'Oréal maintains its leading quality standards by using Ultimaker 3D printers to create precise gauges that allow staff to spot-check product label placement.

Quality assurance devices can be updated with reduced lead times when a new product needs to be produced

Print requirements:

- Tight tolerances
- Low friction coefficient
- Wear-resistant for everyday use

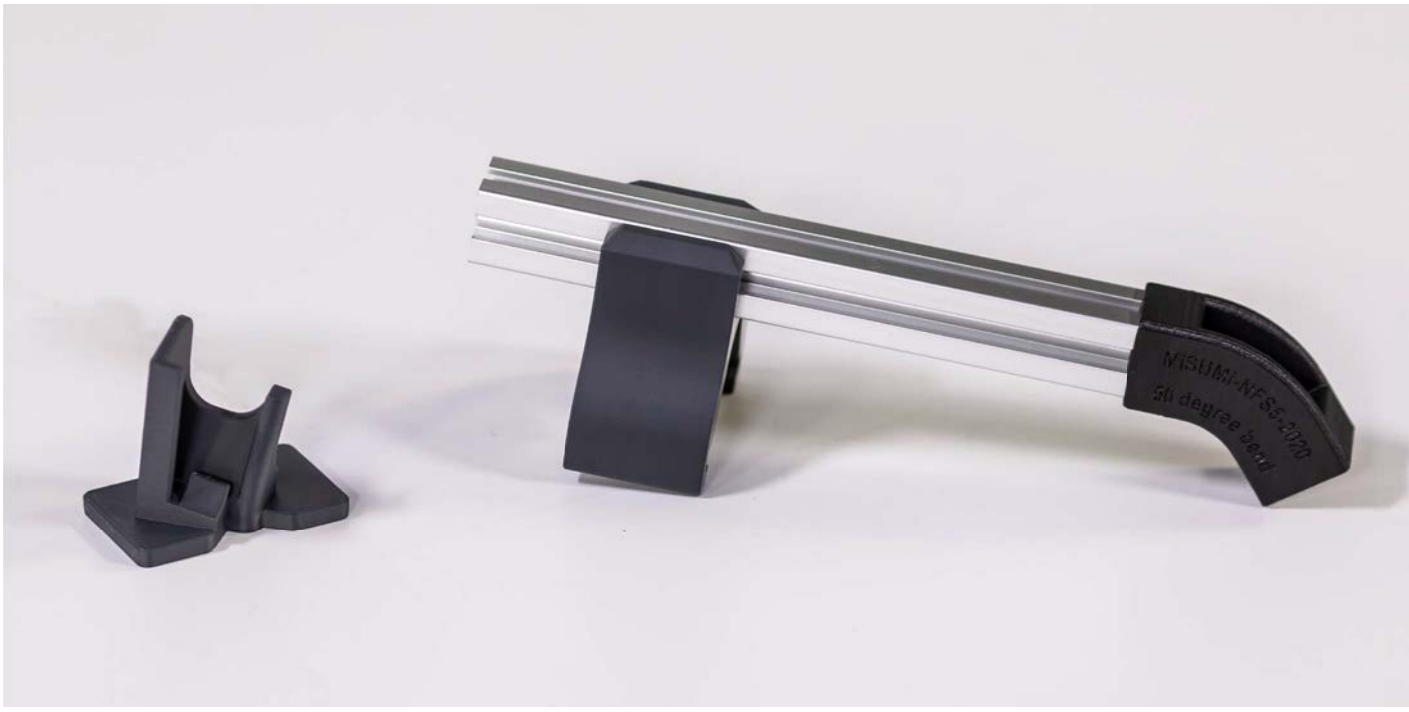
Material match:

DSM Novamid® 1030

Modular extrusion systems

Across many industries, extrusion profiles are used to create modular structures and assembly stations using end effectors and add-ons.

But off-the-shelf parts have limited functionality. 3D printing offers complete flexibility to optimize this modular structural system in any way you can imagine. For example, this connector secures extrusion profiles at an uncommon 55-degree angle, and the sliding jig can hold a camera or sensor.



3D printed parts enable a completely customized modular assembly

Print requirements:

- Load-bearing
- High dimensional stability
- Impact-resistant

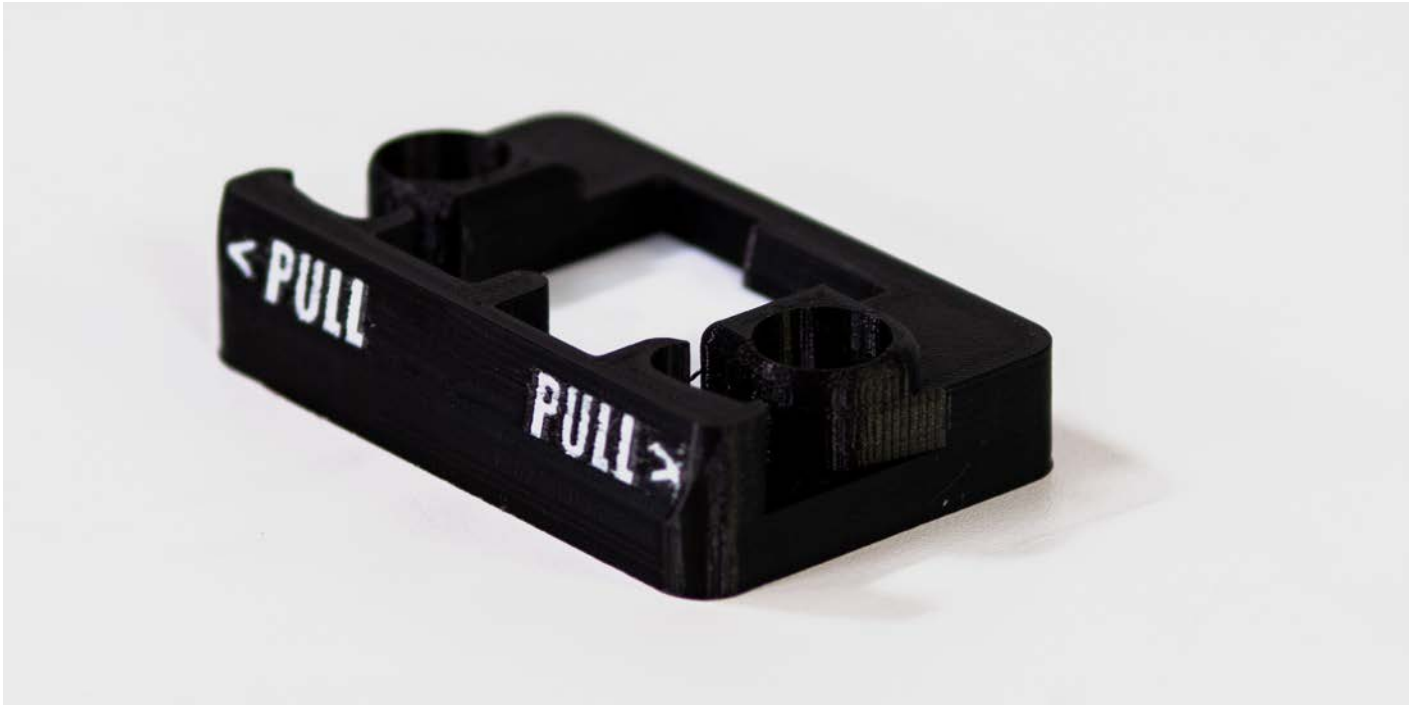
Material match:

BASF PET CF, DSM Novamid® 1030

Sliding block assembly jigs

3D printed assembly tools developed in-house allow you to further optimize for lean manufacturing.

This sliding block assembly tool makes a two-person job easy and repeatable for one operator. The jig ensures two casing halves are snapped together with uniform precision, while keeping a timing belt and spring under tension. The inner walls of the jig are lined with rubber-like TPU 95A material to avoid scratching exterior surfaces.



Printing in two colors allows for clear labels to be printed directly onto parts

Print requirements:

- Wear-resistant
- Impact-resistant
- Reinforced to increase longevity

Material match:

Owens Corning XSTRAND™ GF-30 PP, Ultimaker TPU 95A

Automotive manufacturing aids

Even a small improvement in automotive assembly line efficiency can make a huge difference. Assembling a single car involves thousands of separate tasks, so saving just a few seconds across each of these tasks adds up to weeks of labor time.

In-house 3D printing accelerates the creation of new and optimized tools, jigs, and fixtures. For example, Volkswagen Autoeuropa has improved tool ergonomics by 28% and final product quality by 35%. And that's on top of savings of €475,000 over two years.

Their custom tooling includes gauges to check the dimensions of vehicle components such as windows and seats, a guide for correct placement of the model badges, and a robust protector used during wheel assembly.

This 3D printed wheel protection jig was previously sourced for €800, but can be printed for just €21

Print requirements:

- Semi-flexible
- Wear-resistant for everyday use
- High dimensional stability

Material match:

Ultimaker TPU 95A, Nylon, Tough PLA

Ultimaker

3. End-use parts

With 3D printing, businesses can start building durable, low-volume, customized parts with no tooling cost and next to no lead time. With a wide range of materials, finishings, and a level of accuracy that rivals injection molding, on-demand production can be tailored to your needs, while avoiding costly mass production.

Small-series production

Local manufacturing simplifies supply chains, avoids long lead times, and most importantly, is controlled by you. The Ultimaker S5 printer offers a high print success rate and uptime, market-leading dual extrusion technology, and a spacious build area – making it the perfect in-house tool for scalable small-batch production. Snow Business uses Ultimaker 3D printers to produce the nozzle for their artificial snow machines. These machines are used to create ultra-realistic winter effects in blockbuster movies, hit TV shows, and live events. To achieve this effect, the nozzle has a liquid and airflow geometry so complex that it can only be made by 3D printing.

Snow Business estimates the savings from producing nozzles with an Ultimaker 3D printer provided a return on investment within two weeks

Print requirements:

- Quality similar to injection molding
- Good durability
- Chemical-resistant

Material match:

Dupont Zytel® 3D1000FL

Bridge production

Our customers often discover that high-quality printed prototypes are suitable for end-use parts. This presents an opportunity to any business – simply produce the number of parts you need with additive manufacturing and eliminate the costs of mass production methods. This is known as 'bridge manufacturing'.

Visitors to Amsterdam Airport Schiphol, the third busiest in Europe, will have experienced the benefits of such a solution, but probably not noticed. Inside each airport trash can is a sensor housed in a casing 3D printed with Ultimaker 3D printers. The snap-fit case and lid contain a battery and PCB sensor which alerts staff via Wi-Fi when the trash can is full.

More often than not, unless customer demand dictates a higher volume, the 3D printed final part is perfectly adequate to fulfill the customer's needs.

3D printed casings house sensors inside the top of the containers

Print requirements:

- Good durability
- Chemical-resistant
- Excellent layer adhesion

Material match:

Clariant PET-G

CLARIANT

4. Functional prototyping

Businesses are always in a race to bring new products to market quickly. Rush the development of a product and it could mean missing what the customer needs; take too long and a competitor gets ahead. With the speed and reliability of 3D printing, designers and engineers no longer face this dilemma when testing the functional performance of products. With a 3D printer you can test more iterations at minimal extra cost and go to market with confidence.

End-of-arm tooling

Robotic arms interact with the environment using custom end effectors. Any problem with these grippers and tools on the assembly line results in downtime and money lost. ABB Robotics' industrial robot is programmed to grab, pick, place, and insert components of various shapes with high precision. By 3D printing end effector prototypes instead of outsourcing, which would take up to five weeks for an order, operators retain creative control to test designs more quickly and affordably. And with time freed up by not having to place and wait for orders, engineers have precious extra days to test and perfect their designs.

3D printed end-of-arm parts are far more cost and time efficient than metal, with no reduction in capabilities

Print requirements:

- Good stiffness
- Non-brittle
- Impact-resistant

Material match:

Ultimaker Tough PLA

Ultimaker

5. Casting

With 3D printing, it isn't only possible to replace other manufacturing methods, but also complement them. 3D printed prototypes can speed up the investment casting process as an alternative to creating metal prototypes in the early stages of the process.

Printed samples for investment casting

Investment casting itself is not necessarily an expensive process. But creating the tooling for it is. 3D printed prototypes give Sylatech's customers an extra approval opportunity before any tooling is made. These prints reduce the level of tooling modifications from 30% of orders to 5%, and cut costs by up to 96%.

Clients can now get a prototype metal part in just seven days, improving the results for customers and also enabling Sylatech to take on more orders.

Casting in metal from a 3D printed prototype

Print requirements:

- Compatible with PVA support material
- Low heat-resistance
- High resolution surface quality

Material match:

Ultimaker PLA

Ultimaker

6. Get started – the 3D printing workflow

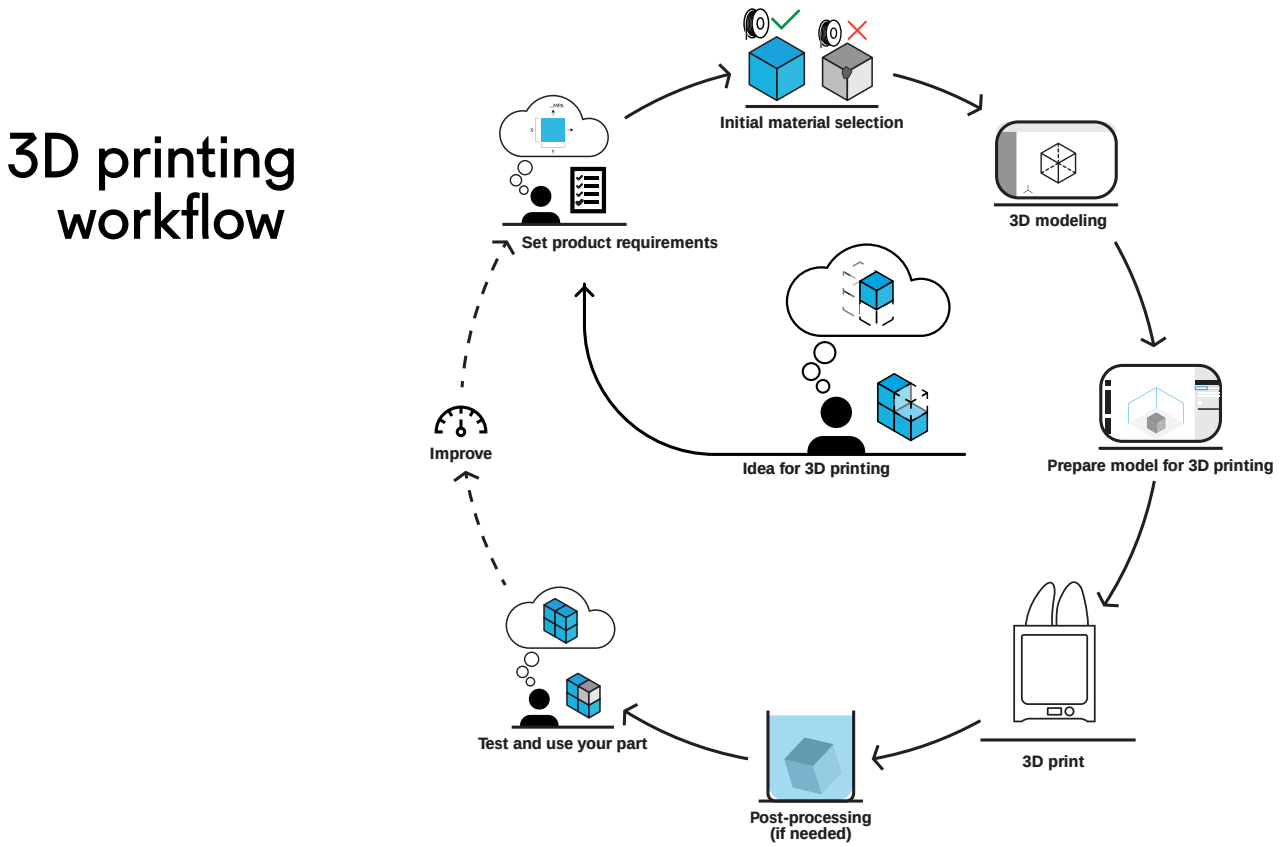
After reading this white paper, we recommend you look around of your studio workstations and production line and analyze all the parts you could be producing with 3D printing. Remember to include metal parts, which can often be produced much more quickly with polymers, with added ergonomic and storage benefits.

Once you know what you intend to 3D print, that is one half of the work you need to do to implement 3D printing. The other half is deciding how you will use 3D printing. This varies depending on the scale of your business, the skills of your team, and what you need to produce.

We will guide you through the basics here. For a closer look at key topics such as choosing a printer and designing parts for 3D printing, you can download more guides at ultimaker.com/knowledge.

Step 1: Understand the 3D printing workflow

Take a look at the diagram below which outlines the typical workflow for a fused filament fabrication (FFF) 3D printer, such as Ultimaker.



This is the workflow you will need to be able to put in place to achieve similar success to the applications in this white paper. On the plus side, you will notice no points in the workflow labeled anything like, "Send design to supplier and wait for two weeks". On the other hand, each point presents decisions you need to make before you can implement the 3D printing workflow.

Some of the key questions it should bring to mind are:

- Which 3D printer is right for me? How many do I need?
- Which materials will I print with? Are they easily available?
- Do we have the necessary CAD skills in the team? And software packages?
- Where will we install the printer (or printers)?

With an understanding of how 3D printing works, you are ready to start answering some of these questions and putting in place a workflow optimized for your business needs.

Step 2: Define your requirements

Divide your planning into two separate areas. One is the technology you are investing in (materials, software, hardware), the other is your current situation (skills, facilities).

With a lot of options on the market, thinking carefully about the requirements for the technology solution you invest in will make a big difference to how effectively you use it. But it is worth noting that with desktop 3D printing there is no penalty to scaling up, so you can validate the concept with one 3D printer before investing in more.

Your chosen 3D printer should be able to print the materials you need to manufacture with, so make material compatibility a key requirement.

For each application in this white paper, we have suggested a material match that would be ideal for that part. All of these materials are not only compatible with Ultimaker 3D printers but feature preconfigured profiles in Ultimaker Cura, our free print preparation software. Preconfigured profiles ensure optimal results when using a certain material and printer without the need for manually entering all the printing parameters. Profiles for third-party manufacturers can be downloaded via the Marketplace in Ultimaker Cura.

For high-strength applications you may also want to consider using composite materials – polymers reinforced with fibers such as glass or carbon. Using an Ultimaker S5 printer with a wear-resistant nozzle – the print core CC Red 0.6, available separately – you can reliably print with composites which would otherwise cause issues such as clogging and abrasion.

The print core CC Red has a wear-resistant ruby cone for printing abrasive composites

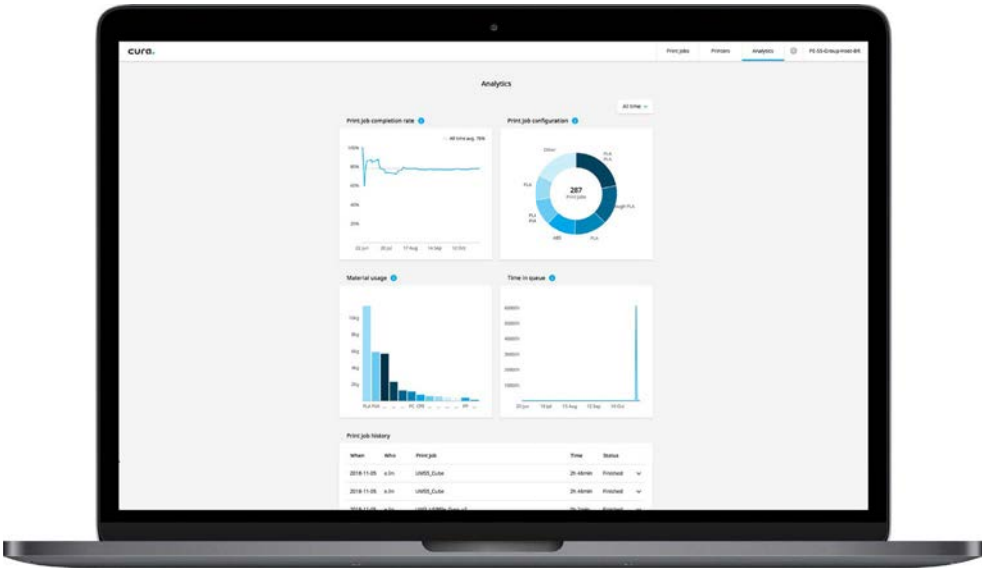
Software is the next part of the 3D printing solution to consider. Print preparation (or 'slicing') software takes your 3D model from CAD output and turns it into instructions the 3D printer can understand, allowing you to choose print settings such as speed and detail.

Trusted by over two million users and free to download, Ultimaker Cura features preconfigured material and printer profiles that let you get a print started in seconds. If you want, you can also tweak the hundreds of settings to get the exact results you need.

Ultimaker Cura is compatible with industry standard CAD file outputs, including STL, 3MF, and OBJ files. Ultimaker has even developed plugins for specific 3D modeling suites (such as SolidWorks and Siemens NX) that enable direct 3D printing from CAD software, as well as direct integration built in to Autodesk Fusion 360 and HP's 3D scanning software. This hugely simplifies the software integration process and workflow.

Step 3: Plan your workflow, put it into practice

With your 3D printer, materials, and software chosen you are ready to get started. If you have a network-enabled Ultimaker 3D printer, Cura Connect makes it easy to manage your print jobs and printers. Use this software built into Ultimaker printers to effortlessly queue print jobs and monitor their progress, as well as track maintenance tasks and material usage.



Cura Connect analytics give you top-down insights into your 3D printing operations

Print jobs can also be started by transferring a file from your computer to Ultimaker 3D printer via USB stick. But using Cura Connect will help you maximize the uptime of your printers by starting new print jobs as soon as others finish, as well as freeing engineers from having to constantly walk over to check on prints. Simply monitor the progress bar and camera feed from your desktop or mobile device. Cura Connect also offers an analytics page that gives you top-down insights into your 3D printing operations, with clear data visualizations of key metrics such as print completion rate and material usage.

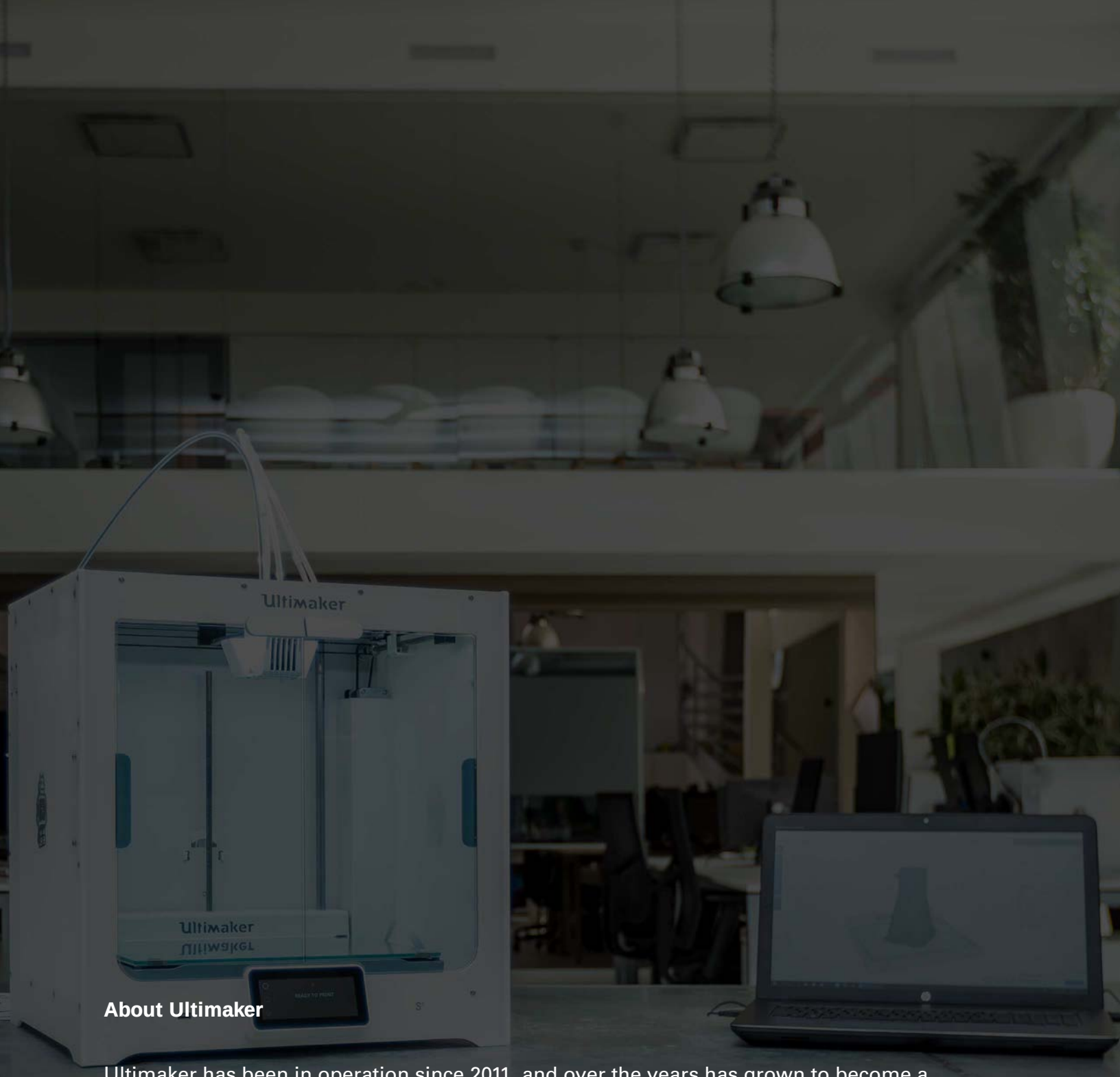
By combining the powerful Ultimaker 3D printing platform and integration with industry-leading software and materials, you have all the tools you need to improve your manufacturing processes.

Explore more 3D printing knowledge

You can learn more from industry leaders and experts, and compare the specs of our 3D printers, on the Ultimaker website.

Read more 3D printing resources

Compare Ultimaker 3D printers



About Ultimaker

Ultimaker has been in operation since 2011, and over the years has grown to become a market-leader; creating powerful, professional, and accessible desktop 3D printers with offices in the Netherlands, New York, Boston, and Singapore plus production facilities in Europe and the US. Ultimaker's team of over 300 employees continually strives to offer the highest-quality 3D printers, software, and materials on the market to accelerate the world's transition to local digital manufacturing.

General inquiries: info@ultimaker.com
Find a local reseller: ultimaker.com/en/resellers

Ultimaker