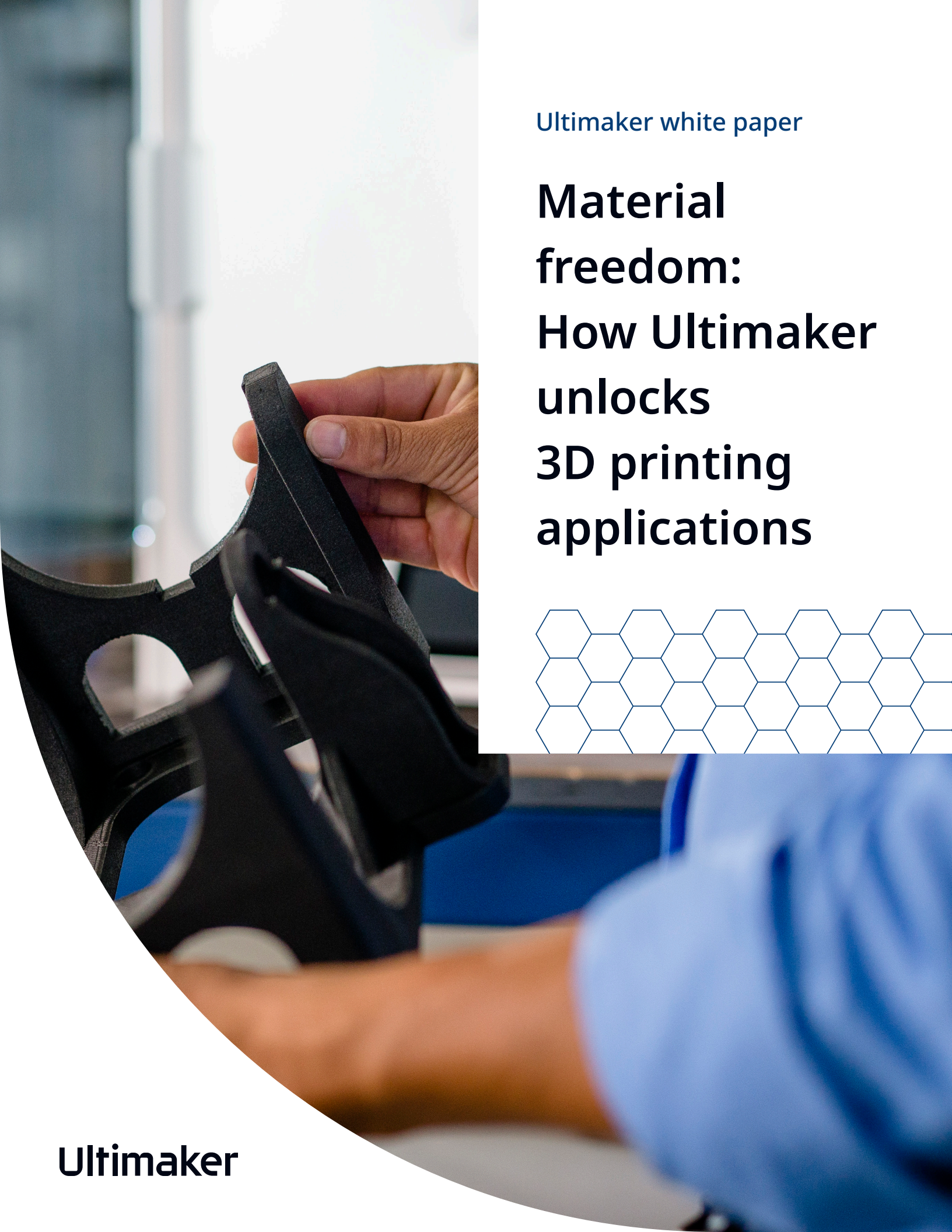

Ultimaker white paper

Material freedom: How Ultimaker unlocks 3D printing applications

Ultimaker

Material freedom: How Ultimaker unlocks 3D printing applications

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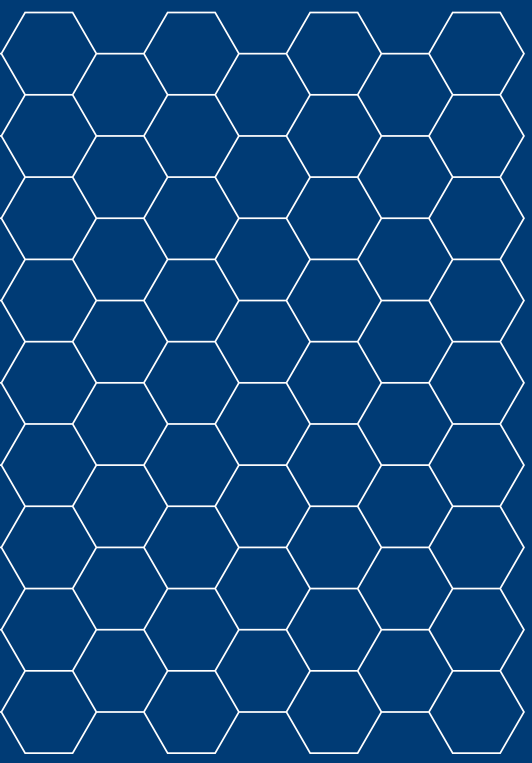

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Introduction

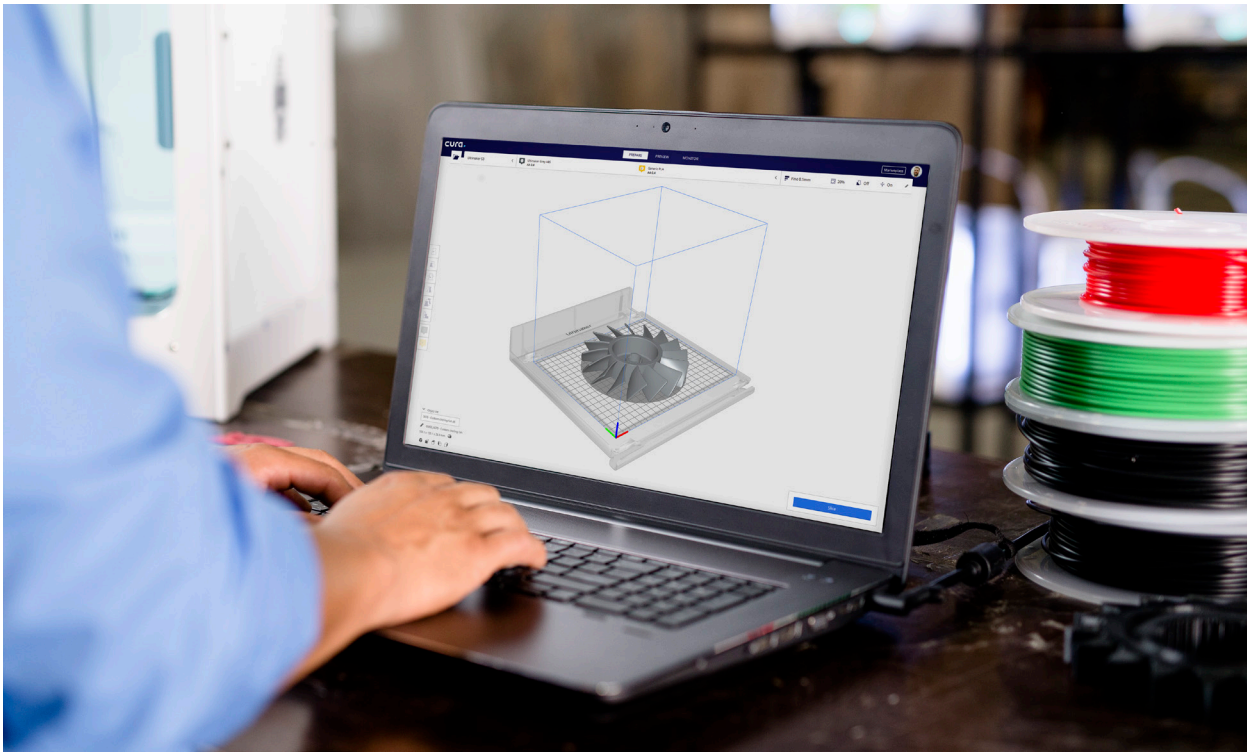
Fused filament fabrication (FFF) 3D printing provides clear benefits over traditional prototyping methods. Print a design, evaluate the concept, iterate, go to market – it's simple, cost-effective, and efficient.

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

More materials, more applications

One of FFF printing's greatest strengths is the number and variety of materials it can use. Ultimaker 3D printers have been optimized to use the Ultimaker range of materials. But our flexible and open platform makes it possible to use 2.85mm filaments from other vendors.

This white paper highlights some of the 3D printing applications that demand high-performance materials. Each chapter includes examples of real 3D printing applications and the Ultimaker-compatible material used. The white paper ends with a step-by-step guide to setting up your 3D printing workflow to achieve these results.



Tools, jigs, and fixtures

Tools, jigs, and fixtures are custom-made parts that make manufacturing easier. Their production has traditionally been outsourced to an external supplier or in-house service bureau. This process has a number of drawbacks – high material costs, long lead times, and excess storage requirements. And if there is a quality issue with an item, it could be weeks before an improved iteration is ready.

With a 3D printer you can fabricate parts on demand, for a fraction of the material costs, and can iterate as needed.

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

Quality assurance tools

Quality management is an essential part of any production line. And due to their simple design, many devices that check for and prevent defects and errors can be 3D printed. These include 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 when new products are launched, with reduced lead times

Print requirements:

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

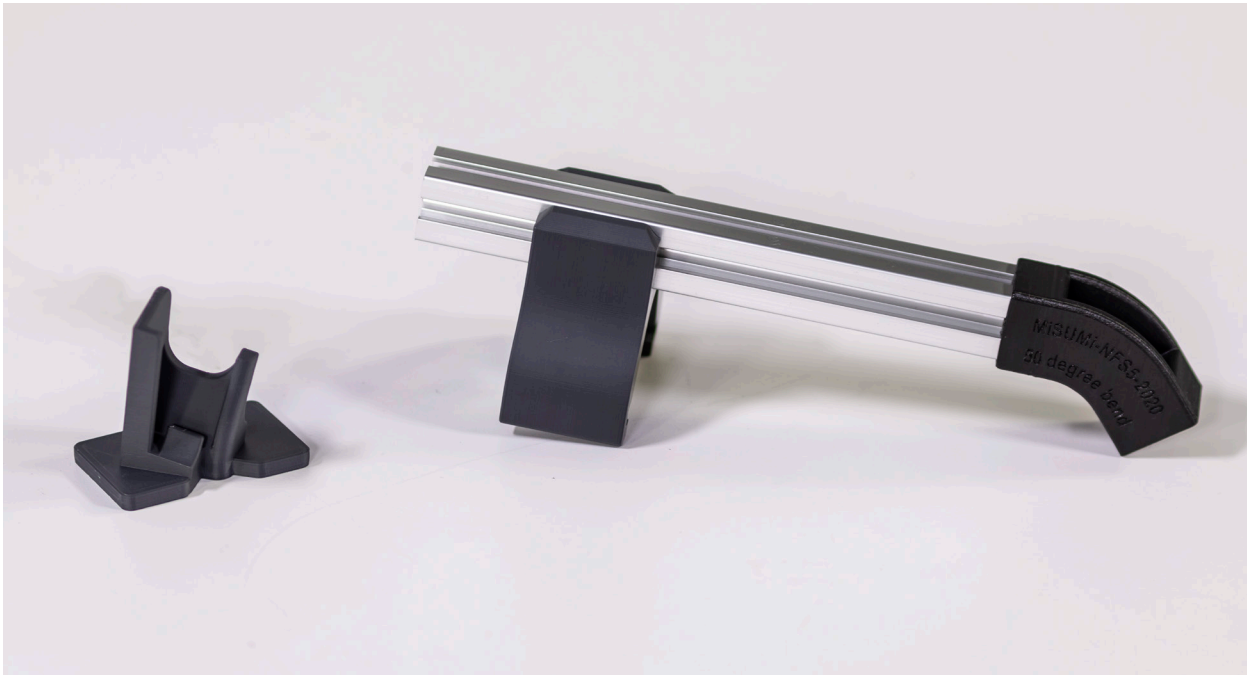
Material match:

DSM Novamid® 1030

Modular extrusion systems

Extrusion profiles are used to create modular structures that use end effectors and add-ons, but off-the-shelf parts have limited functionality.

3D printing enables you to optimize modular systems in any way you can imagine.
The pictured connector secures extrusion profiles at an unusual 55-degree angle, while 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

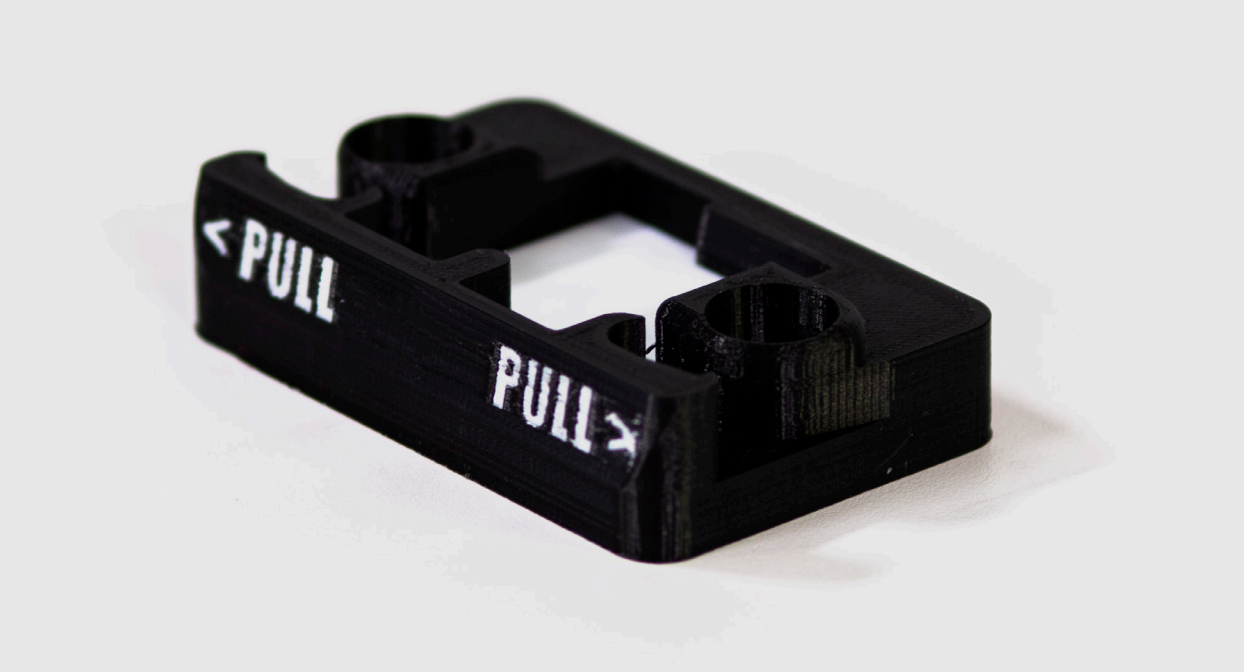
Material match:

BASF PET CF, DSM Novamid® 1030

Sliding block assembly jigs

When in-house 3D printing assembly tools, you can optimize your production processes for lean manufacturing.

The sliding block assembly tool pictured below, makes a two-person job easy and repeatable for one operator. The jig ensures that 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 to productivity. 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, a guide for the correct placement of model badges, and a robust protector used during wheel assembly.

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

End-use parts

On-demand fabrication can be tailored to your needs, avoiding costly mass production. With 3D printing, businesses can build durable and low-volume customized parts, with no tooling cost and minimal lead time. FFF 3D printing also provides a wide range of materials and finishes, and accuracy that rivals that of injection molding.

Small-series production

In-house manufacturing simplifies supply chains, avoids long lead times, and places you in control of production. Snow Business uses Ultimaker 3D printers to produce the nozzle for their artificial snow machines. These create ultra-realistic winter effects in blockbuster movies and hit TV shows. 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 that 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 manufacturing

Businesses often discover that high-quality 3D printed prototypes are suitable for end-use parts. This presents an opportunity – simply produce the parts you need 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 unknowingly experienced the benefits of such a solution. Inside each airport trash can is a sensor, housed in a casing fabricated by 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.

3D printed casings house sensors inside the trash can

Print requirements:

- Good durability
- Chemical-resistant
- Excellent layer adhesion

Material match:

Clariant PET-G

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Functional prototyping

Businesses are in a race to bring new products to market. With the speed and reliability of 3D printing, designers and engineers can test more product 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. Problems with these grippers and tools result in assembly line downtime and money lost. ABB Robotics' industrial robot is programmed to precisely grab, pick, place, and insert components of various shapes. By 3D printing end effector prototypes, operators retain the ability to test designs quickly and affordably. And with up to 5 weeks saved, compared with outsourcing, engineers have precious time to test and perfect their designs.

3D printed end-of-arm parts are 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

Casting

3D printing doesn't just replace other manufacturing methods, it can also enhance and complement them. For example, 3D printed prototypes can speed up the early stages of the investment casting process, by removing the need for metal prototypes.

Printed samples for investment casting

Investment casting isn't 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. On average, 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 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

The 3D printing workflow

Identifying what you intend to 3D print is only the first part of your FFF journey. Next, you need to decide 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.

By eliminating outsourcing, your development cycles will be faster. But you will need to answer a few key questions before you start 3D printing in-house:

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

Once you have answered these questions, you are ready to initiate a workflow optimized for your business needs.

What follows is a basic guide to 3D printing. 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/learn.

Step 1: Define your requirements

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

For each part mentioned in this white paper, we have suggested a suitable material. 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 by eliminating the need to manually enter all printing parameters. Profiles for many third-party material manufacturers can be downloaded via the Ultimaker Marketplace.

For high-strength applications you may also want to consider composite materials – polymers reinforced with fibers such as glass or carbon fiber. Using an Ultimaker S-line 3D printer with a wear-resistant nozzle – the print core CC Red 0.6, available separately – you can reliably print composites without damaging your hardware.

Your chosen 3D printer should be able to print the materials you're likely to require, so make material compatibility a key requirement.

It's also worth noting that there is no penalty to scaling up your use of 3D printing, so you can pilot the process with one 3D printer before investing in more.

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

Software is the next critical component of a 3D printing solution. Print preparation, or slicing, software such as Ultimaker Cura takes your 3D model from a CAD output and converts it to a format a 3D printer can understand.

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. You can also tweak the hundreds of settings to get the results you need.

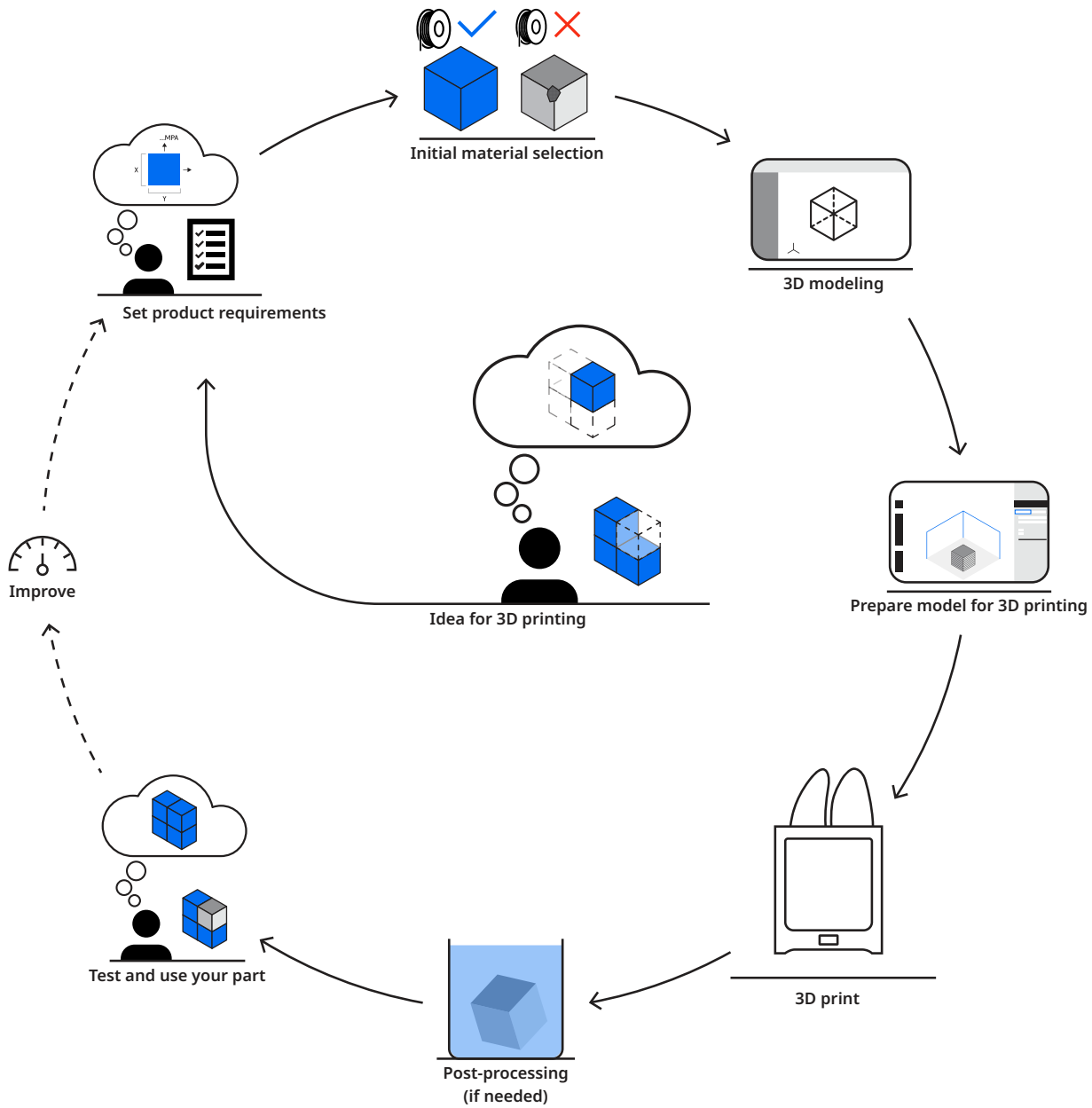
Ultimaker Cura is compatible with industry standard CAD file outputs, including STL, 3MF, and OBJ files. Ultimaker has even developed plugins for specific 3D modeling suites (such as SolidWorks and Siemens NX) that enable direct 3D printing from CAD software. These plugins also offer direct integration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

Step 2: Understanding the 3D printing workflow

With your 3D printer, materials, and software chosen, you are ready to implement a 3D printing workflow that works for your business.

As an example, the diagram below outlines a typical workflow for a 3D printer such as those in the Ultimaker S-line of FFF printers.

3D printing workflow



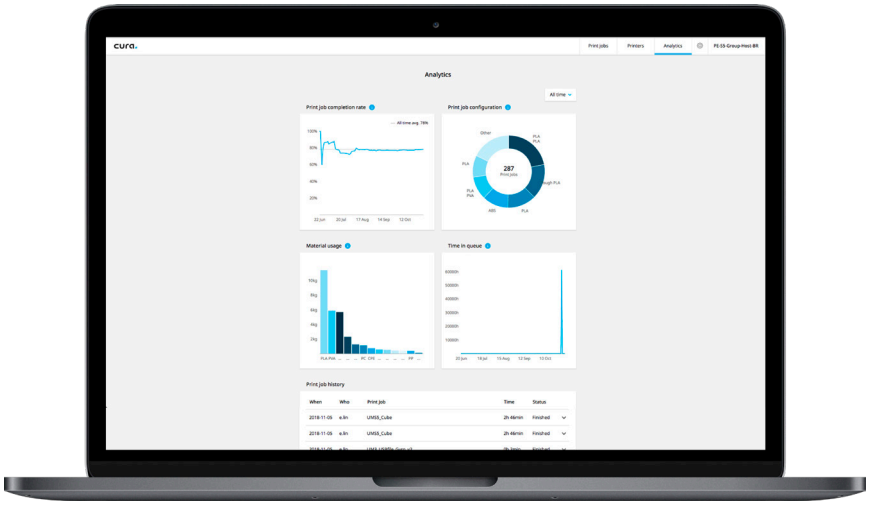
Step 3: Manage your 3D printing processes

If you have a network enabled 3D printer, Ultimaker Connect makes it easy to manage your print jobs and monitor their progress, as well as track maintenance tasks and material usage.

Using Ultimaker Connect helps you maximize printer uptime, by starting new print jobs as soon as others finish, freeing engineers from constantly having to check on prints. Simply monitor the progress bar and camera feed from your desktop or mobile device. Ultimaker Connect also offers an analytics page that gives you top-down insights into your 3D printing operations, with clear visualizations of key metrics such as print completion rate and material usage.

Ultimaker Cloud offers a host of plugins and material profiles to make printing faster and easier. And if you need to back up your preferred settings to the cloud for global availability, or print from anywhere in the world, Ultimaker Cloud makes this possible.

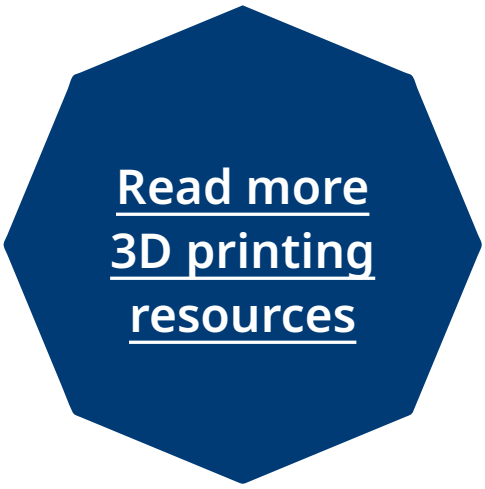
By combining the powerful Ultimaker 3D printing platform and integration with industry-leading software and materials, you have all the tools you need to improve your manufacturing processes.



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

Explore more 3D printing knowledge

You can learn more from industry leaders and experts, or request a quote, on the Ultimaker website.

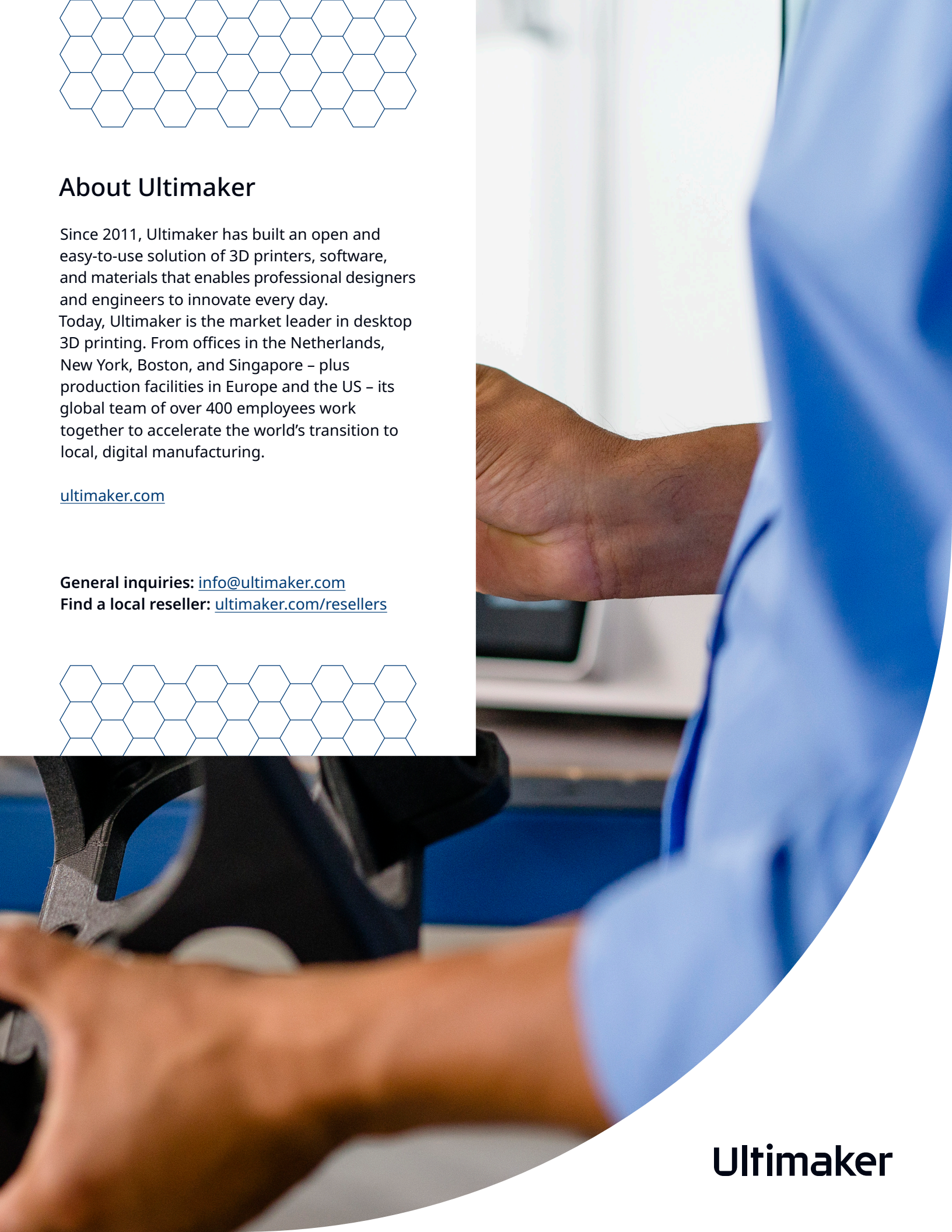


About Ultimaker

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.com

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



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