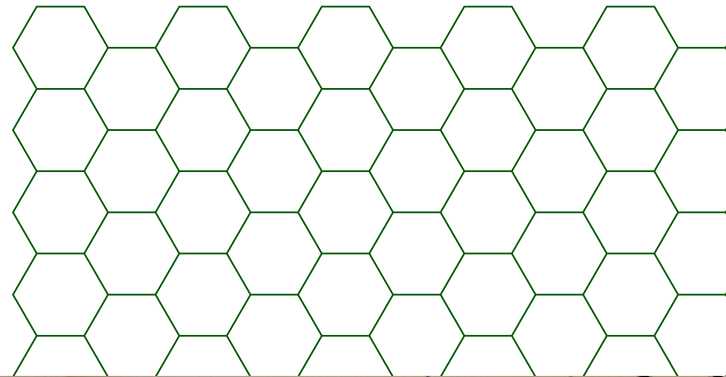




Ultimaker white paper

**Setup to
success:
3D printing
for product
designers**



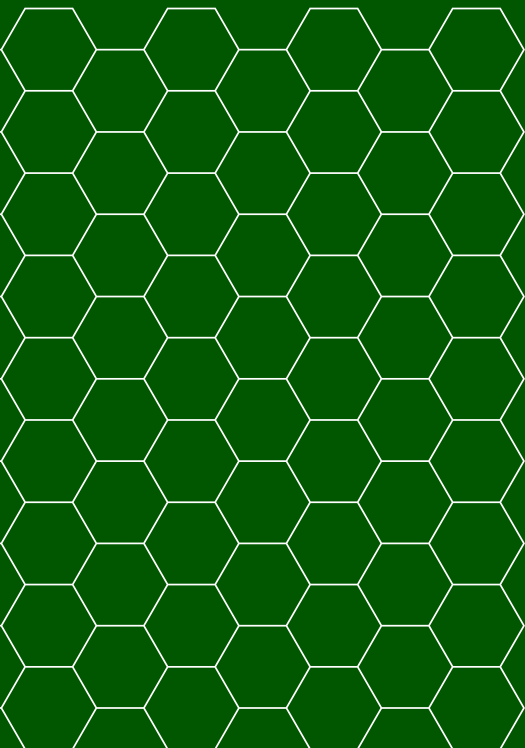
Ultimaker

Setup to success: 3D printing for product designers



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Introduction

In the past, product designers had limited options in the development cycle: rush development and risk quality, or slow development and risk being beaten to market by a competitor. With 3D printing, designers can test more iterations at almost no additional cost, and go to market with confidence.

What you will learn

This guide will help you achieve the benefits of 3D printing as quickly as possible. Using Ultimaker fused filament fabrication (FFF) printers as examples, we will look at:

- How to set up your printer and optimize your workspace
- How to implement a 3D printing workflow
- How to make the most of 3D printing, with application ideas

This guide has been created by Ultimaker's 3D printing experts. It also features examples from real-life product designers, so you can learn from those already using 3D printing to reduce production time and costs.



Setup

To start using your 3D printer as quickly as possible, you should consider a few things in advance. How is it installed? Where will it be located? Who will use it?

Unboxing

Before your 3D printer arrives, visit ultimaker.com for useful resources, or watch one of our videos to help you understand your printer's features and guide you through setup (e.g. the [features explained](#) and [unboxing](#) videos for the Ultimaker S5).

Each Ultimaker printer comes with a quick-start guide detailing how to unpack and install the printer and start your first print. The first time you turn your printer on, it will ask you to complete simple setup actions: choose the language, install the build plate and print cores, load material, connect to a network (optional), and check for the latest firmware.



Unboxing the Ultimaker S5 printer

Location

Desktop 3D printers are considered clean and safe for an office environment, depending on the material being printed, and are quiet enough to be placed on a desk. But if a single 3D printer serves multiple users, or you have a multi-3D printer setup, it may be best to create a central 3D printing area.

As Ultimaker 3D printers do not exceed a maximum noise level of 50dB, noise isn't usually a problem when running a single printer. But when running multiple 3D printers, it is better to place them in a separate area to reduce overall noise levels.

Ventilation should be considered when using materials with safety requirements, or which produce an unpleasant odor. You could also consider an air management accessory, such as the Ultimaker S5 Air Manager, which removes up to 95% of ultrafine particles (UFPs). Ultimaker provides [safety data sheets](#) for every Ultimaker material, so you can identify each materials' safety requirements.

Operation

Ultimaker 3D printers are designed to ensure reliability and maximum uptime, and are certified for safe unattended use. This means that you can leave your printers to run unattended, for maximum efficiency.

Files can be uploaded to the 3D printer via USB or a network connection. With Ultimaker Connect and Ultimaker Cloud, you can start and manage print jobs remotely, access print analytics, and save your print settings to the cloud for remote access.

Personnel

Ultimaker 3D printers are designed to be simple to use, so you're unlikely to need specialist training or a new team member to use them. You may, however, need a dedicated operator when running more than 10 printers.

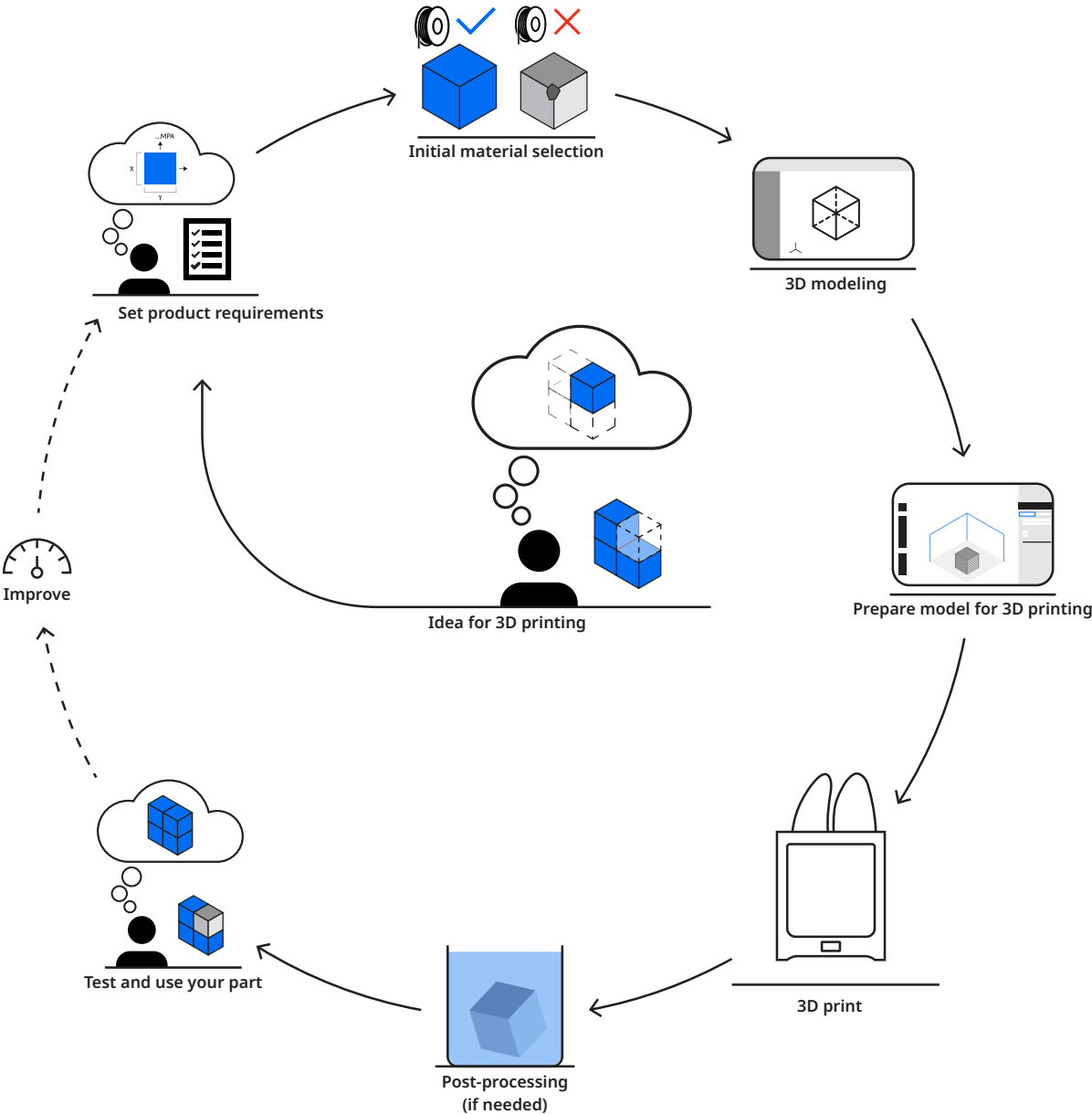
To optimize results, staff should be trained to design for additive manufacturing (DfAM). A good introduction to this concept is our free '[How to design for FFF 3D printing](#)' guide. Your reseller may offer more in-depth training.

Once your team and workspace are ready for 3D printing, it's time to implement a workflow that streamlines production.

Workflow

An efficient workflow will improve the quality of your 3D prints and reduce the time it takes to achieve a return on investment.

To help get you started, we have provided a typical 3D printing workflow below:



Material selection

Material selection is critical to a successful 3D print. Ultimaker 3D printers are optimized to use the Ultimaker range of materials, but can also use third-party materials. Many material manufacturers provide print profiles for their filaments in Ultimaker Cura, for optimal print results.

Here are a few of the most popular materials:

- **PLA** prints quickly and easily, and is the lowest cost 3D printing material, making it perfect for early-stage concept testing and prototypes
- **PVA** support material dissolves in water, enabling complex geometries
- **PP** offers good chemical, water, and electrical resistance, making it ideal for applications such as living hinges

More information on choosing the right material can be found on the [Ultimaker website](#).

3D modeling

When designing for 3D printing, there are seven key considerations, based on the geometry and features of your part:

1. **Nozzle size.** Consider the diameter of the nozzle you use. The minimum wall thickness of your part should be equal to or larger than your nozzle's diameter
2. **Bottom layer.** The bottom layer is the foundation of your 3D print. The larger its surface area, the better its adhesion to the printer build plate. Use chamfers instead of fillets for edges that touch the build plate, as rounded corners are more effective than sharp ones
3. **Support material.** Dual extrusion printers can print support material within overhangs or cavities to enable more complex geometries. This does, however, increase print and material costs. Limit the use of support material by creating overhangs with an angle greater than 45-degrees
4. **Small details.** For designs featuring small details, use a smaller nozzle. Ensure that small details have time to cool before the next layer is printed
5. **Tolerances.** Plastic polymers shrink when heated and then cooled. This needs to be considered when designing parts with specific size requirements. With some materials (such as PLA), this is usually unnoticeable, but some filaments may require test printing
6. **Fast printing.** If print speed is important, you can reduce the thickness of the bottom or the walls of your print, or choose a larger nozzle diameter
7. **Modularity.** FFF 3D printers are only able to print parts that fit within their build volume, but this doesn't make them unsuitable for producing large objects. Instead, use a modular design, consisting of multiple components, that can be printed more rapidly

Preparing your 3D model for printing

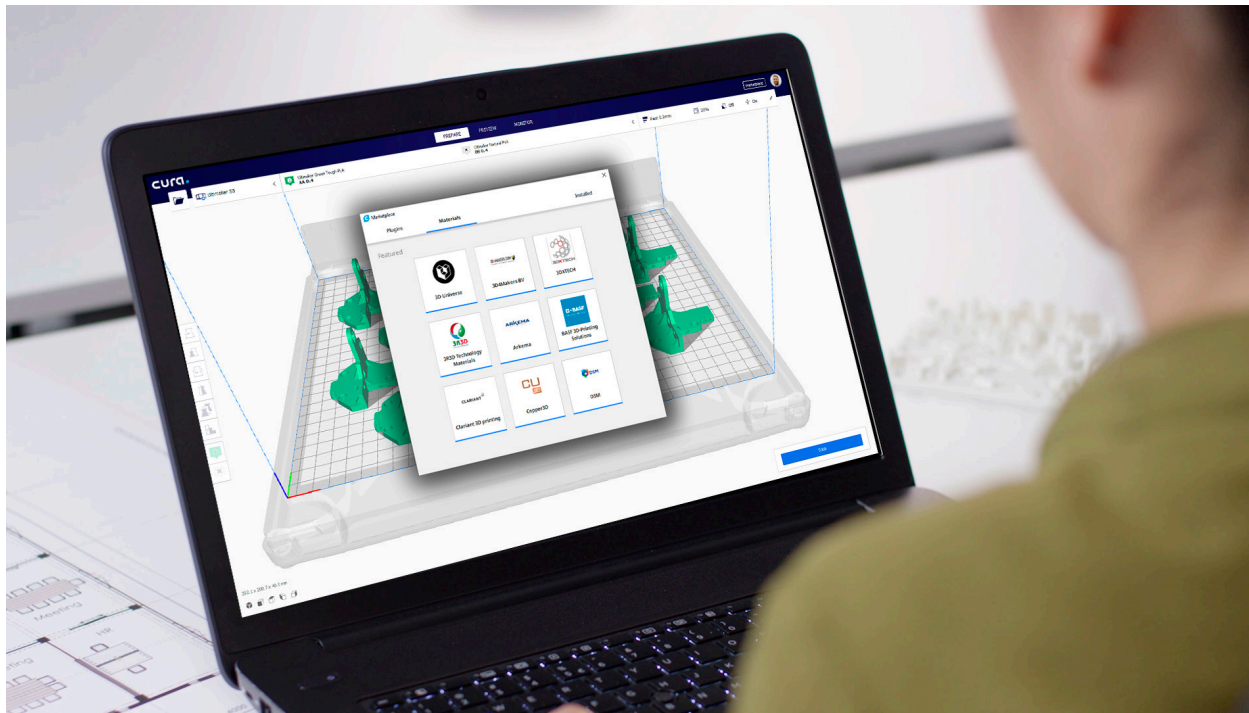
Once you have a 3D design file, you can transfer it to print preparation software that will turn it into instructions for your 3D printer.

Ultimaker Cura is the most widely used 3D printing software in the world, with millions of users, and is [free to download from our website](#).

In Ultimaker Cura's Recommended mode, printing is as easy as loading your model design, choosing key settings (layer height and infill density), and starting your print. You can also switch to Custom mode and tweak multiple settings for highly customized results.

With Ultimaker Cura you benefit from the open and integrated Ultimaker ecosystem. Here you will find:

- Preconfigured material profiles from leading filament producers, including BASF, Clariant, DSM, DuPont, and Owens Corning
- 'Print from CAD' integration with free plugins for SolidWorks, Autodesk Inventor, and Siemens NX



Extra print profiles and software integration can be downloaded in Ultimaker Cura

Printer operation

When you have prepared your print in Ultimaker Cura, you can save it to USB or print via a network.

Ultimaker [Connect](#) is a network print management tool that enables you to queue multiple print jobs, monitor print progress, and track maintenance and printing analytics from your desktop.

This is particularly effective if you have multiple 3D printers. You can create groups of printers for use by different teams, or with a frequently used configuration. Queued print jobs will start automatically when a printer with a matching configuration becomes available.

With the Teams feature in Ultimaker Cloud, your 3D printers are accessible to all team members – regardless of where they are, or the network they're on.



Post-processing

When your print finishes, wait for the build plate to cool, then remove the part. If it sticks, use a spatula to free it from the build plate.

Often, the only post-processing needed is to remove the thin brim added to your print for optimal adhesion. This can be done by hand or with a small modeling or hobby knife.

If you used water-soluble support material such as Ultimaker PVA, you will need to dissolve it before you can use your print. Manually detachable supports, such as Ultimaker Breakaway, can be removed with a pair of pliers.

Once supports are removed, you can start additional post-processing options, such as:

- Sanding, for a smooth surface finish
- Polishing with a plastic polish compound
- Gluing modular parts together using a modeling or industrial adhesive
- Painting your print, using a primer and separate top coat
- Screw threading

Not all post-processing techniques are suitable for all materials, so be sure to research and test your chosen method before trying it on your final part. Follow the manufacturer's guidelines for any off-the-shelf products you use in post-processing.



Removing PVA (left) and Breakaway (right) support material

Application ideas

3D printing gives product designers a powerful competitive edge – avoiding outsourcing and speeding up the product development cycle. With Ultimaker's fast and reliable 3D printers, you can test more iterations at almost no additional cost and go to market with confidence.

But how do you ensure that you are maximizing your return on investment? This list of application ideas will help you make the most of your 3D printer.

Concept directions

To determine the direction of your design, choose from a selection of concepts in the early design stages.

Tip: Use multiple material colors for your printed prototypes, to differentiate options and iterations.



Shape and form

Check the size and proportions of your product or one of its components, with a basic model to check form and aesthetics.

Tip: PLA is good for creating precise models, due to its excellent dimensional accuracy.



Functional prototypes

Test products in as close to real-world conditions as possible, to verify your product's fit, function, and manufacturability.

Tip: Explore different materials for functional prototyping needs. Nylon offers low friction and high impact strength for mechanical parts, while CPE+ can withstand temperatures of up to 100 °C.



Look and feel

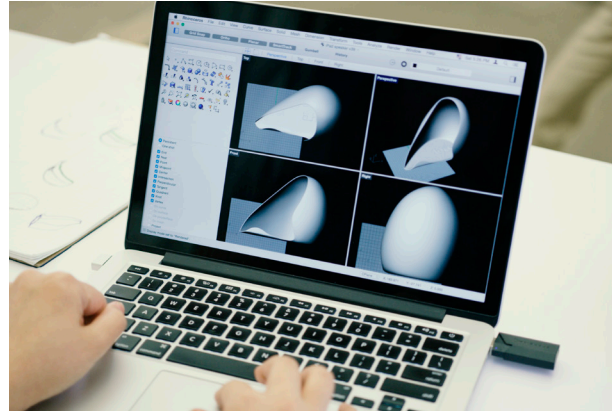
Test user reactions to the aesthetics and experience of prototypes. You can bring the product to life with multiple colors, or materials that simulate the final vision.

Tip: Use post-processing techniques to achieve high levels of detail and complete customization.



Case study: Bhold

Creating up to 100 iterations per product, Bhold has significantly minimized risks, shortened time to market, and reduced prototyping costs for new product design. 3D printing also enables the company to design beautiful and complex geometries impossible to achieve with traditional alternatives.



“With 3D printing, I was able to launch my first four products to the market within only three months. Traditional methods would require me to already produce the item before making it available, and each individual product takes anywhere between nine months to a year to complete development and production. So, what took me only three months might have taken me years otherwise.”

Susan Taing, CEO / Founder of Bhold

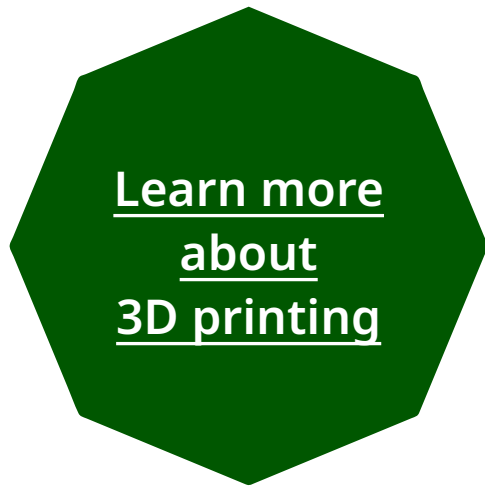
Traditional manufacturing methods don't enable design freedom, and creating prototypes is time-consuming and expensive. This delays product launches, so fewer products can be launched each year. It also makes usability testing more complicated and time-consuming.

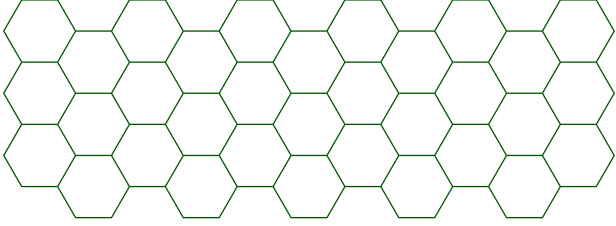
By using Ultimaker 3D printers, Bhold revolutionized its product design process. Creating prototypes is now inexpensive and easy, reducing risk in the development phase. 3D printing removes many of the constraints associated with product manufacturing, giving the company complete design freedom and confidence in the competitive edge of new products.

	External suppliers	Ultimaker 3D printers
Iterations	4 per product	100 per product
Cost	\$250 per prototype	\$13 per prototype
Time	2 weeks per prototype	8 hours per prototype

Take the next step to success

Build your 3D printing knowledge with industry leaders and experts, or request a quote, on the Ultimaker website.





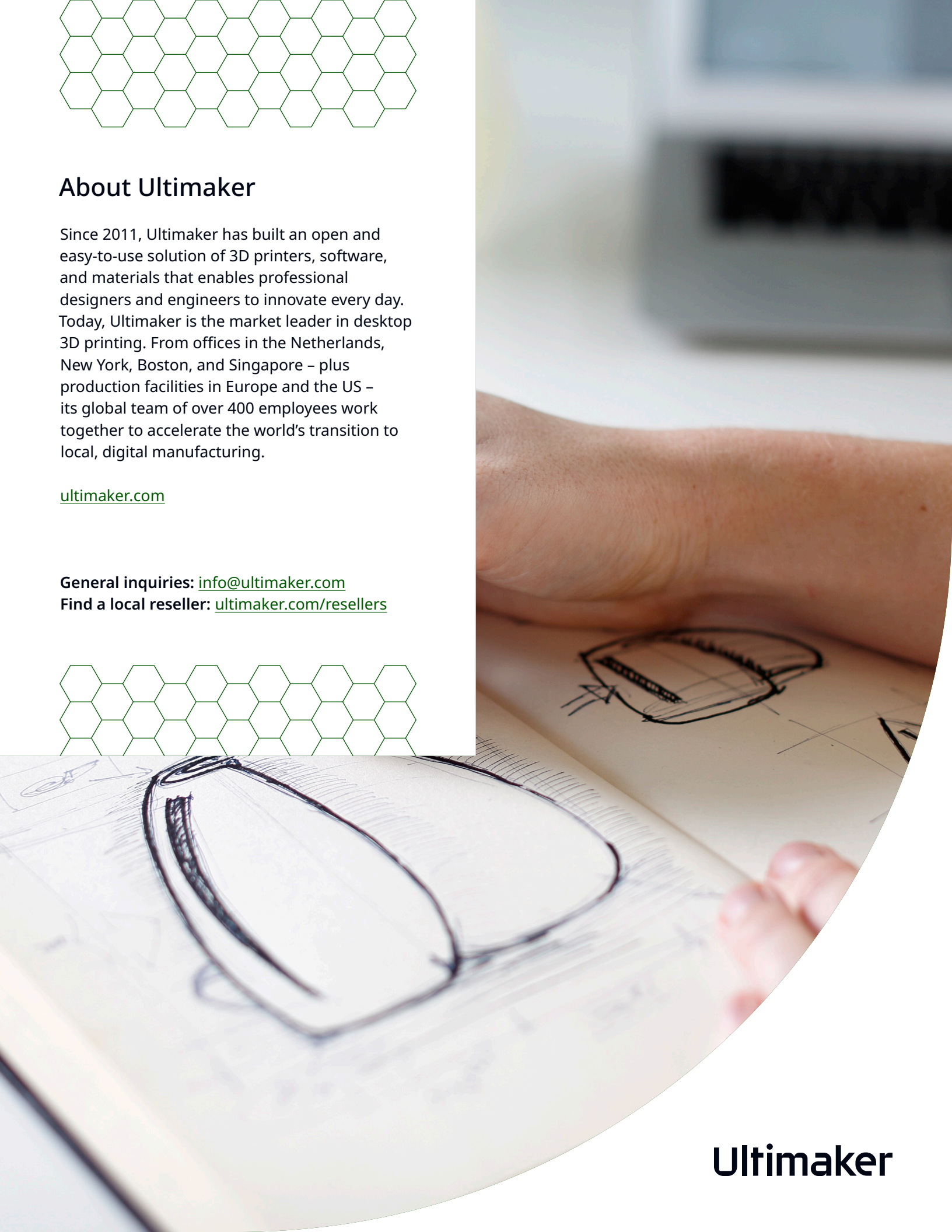
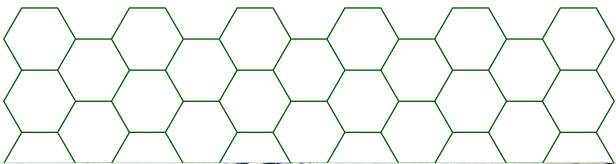
About Ultimaker

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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