



Progress in the Making

Librarians' Practical 3D Printing Questions Answered

Zach Lichaa and Charlie Wapner, May 2016



Office for
Information
Technology
Policy

ALAAmericanLibraryAssociation

Setting the Stage

As the digital transformation of society moves forward, the way we access, process and utilize information continues to change dramatically. In keeping with its historic role as the public's on-ramp to the world of digital technology, the library community is taking the lead in helping people of all ages and backgrounds harness the power of the latest wave of this development: 3D printing. 3D printing technology brings digitization to the economy of tangible things, by allowing people of all ages and backgrounds to use digital processes to create physical items. Recent data collected by the American Library Association (ALA) and the University of Maryland reveals 428 public library facilities that offer 3D printing services. That number is up from about 250 the year before, and continues to grow rapidly. Libraries offering 3D printing services generally make their printers available to anyone with a library card, at no-or-low cost.

The more accessible 3D printing becomes, the more the public will benefit from its transformative power. Therefore, the acceleration of library 3D printing services can and should continue. However, it can only do so if those within the library community have a clear understanding of how to set up, operate and troubleshoot 3D printers. The purpose of this document is to facilitate such understanding among library professionals who have recently acquired a 3D printer, or are considering acquiring one, but have not yet made the final decision to do so. It poses and answers a number of the hottest practical questions surrounding this technology within the library community today.

How much will it cost to purchase a printer and material?

As more companies have entered the market in recent years, the cost of 3D printers has come down. You can purchase a quality 3D printer for as low as \$400 and the cost should not exceed \$1500. You'd be well served to have 2-3 rolls of material in stock at any given time. Each roll will cost approximately \$22. If you're using 2 rolls of material per month and purchase a printer for \$700, that's \$1228 all in for the first year and \$528 in material per year after that.

How much space will we need to allocate inside the library for our 3D printer?

Most 3D printers are equivalent to the size of a desktop computer. Therefore, it's recommended that you allocate the same amount of space you would provide for a computer plus another space the size of a computer to store your materials and accessories.

How difficult/costly is it to get replacement parts from a manufacturer?

Most manufacturers offer a 1 year warranty with the purchase of a 3D printer. These warranties cover defective parts associated with the printer, so provided you are using materials covered under the warranty, your replacement parts will be

covered in full under the warranty. When you purchase the printer, you will know which materials are allowed to be used with the printer and they are generally polylactic acid (PLA) and acrylonitrile butadiene styrene (ABS) plastic, with a few exceptions on higher end printers.

What is the most popular type of 3D printing technology in libraries? Might it be replaced by something else anytime soon?

The most popular form of 3D printing libraries is fused deposition modeling (FDM) technology, which is used by desktop 3D printers. This technology has been the linchpin of consumer and educational 3D printing for years and will continue to be for the foreseeable future.

How reliable are FDM extruders? How long are they designed to last?

The extruder is the part of the printer that deposits material. When thinking about the reliability of FDM extruders, it's best to think in terms of hours. Extruders will last between 5000-7000 hours each, depending on the printer. This allows you to print for 13 hours per day if you print every day of the year with an extruder that lasts 5000 hours. It will be important to clean your extruder every month in order to maximize longevity.



Which computer-aided design (CAD) software is best for training staff and patrons? How frequently does CAD software require updates?

One of the best ways to start when it comes to 3D modeling is to use the web-based software called [Tinkercad](#). Tinkercad is a free web app that runs entirely in the browser, so there's no need for updates or concerns about whether you're on a Mac, Windows, or Linux operating system. As long as you're running a modern web browser, Tinkercad will work for you and your patrons.

On average, how long does it take to print an item? Are some printers faster than others?

The duration of a print is dependent on two primary factors: the size of the print and the resolution you wish to print. An object the size of a Rubik's Cube will take approximately 5 hours to print with standard resolution. The higher the resolution of the print, the lower the speed because the printer is working slower to provide better detail.

Which FDM filament is best to use in a library – PLA or ABS?

It is best to use PLA plastic because it is biodegradable and has shown no problems from a toxicity standpoint. ABS plastic does let off fumes and can emit an odor and therefore, we do not recommend it for libraries.

Given the volatile state of the consumer market, what should libraries consider in selecting a supplier?

It is very important to work with a supplier who will be around for years in order to service your 3D printer. Library professionals should be aware that 3D Systems – a major manufacturer in the U.S. – [recently announced](#) the discontinuation of its line of entry-level consumer FDM printers. However, the number of options on the FDM market has grown significantly of late. As a result, 3D printers are more affordable than ever for libraries. One source of information about the options on the market is *Make*: magazine's [annual buyer's guide](#).

What's the best model for keeping 3D printing services sustainable from a cost standpoint?

This will depend on how often the printer is used. Just as some libraries charge for paper printing, it's feasible for them to charge for 3D printing. One way to approach this is to charge for material. If you purchase the standard 1 kg roll for \$22, this should provide about 35 objects the size of a Rubik's Cube (\$0.62 per print). Therefore, if you charge \$2 per print and your patrons aren't making truly large objects, you should be able to recoup funds for every roll of material used. If the object is going to be larger, you can charge \$4 a print.

How difficult is it to troubleshoot and/or conduct minor repairs on a printer?

While printer troubleshooting and repairs requires staff time and energy, most manufacturers have good customer support which comes free with your printer purchase. They can guide you through the process should there be a minor issue via phone and email.

Can you offer any tricks of the trade for minimizing bad prints?

Paying attention to temperature controls and the surface of your print bed (build plate) will minimize bad prints. Every material you purchase will have an optimal temperature range in which to print and it's important to follow these guidelines. You will be able to control the print temperature via the software which is included with your printer. With regard to the surface of your print bed, most new printers come with quality build plates but if you want to go above and beyond, a company called BuildTak sells sheets you can apply to the build plate and then easily peel off each month.



Can anything be done to reduce the noise of the printer while it's operating?

3D printing companies are aware that noisy printing deters customers; therefore the newer machines have become quieter across the board. Beyond that, you should place the printer in an area where a small amount of noise is not completely prohibited and you can also look to purchase a printer with an enclosed frame. Not all printers come with an enclosed frame but some do.

What is the most common type of CAD file? Is it compatible with any 3D printer?

STL (STereoLithography) is the most common file type for desktop 3D printers. Some manufacturers will print in their own format but the good news is their software

will automatically convert the STL you have downloaded or created in software automatically.

Are there any tips for building highly intricate items?

Slicing software allows you to print with extra supports if your print has a lot of overhang and will need to be held upright during printing. Two common slicing software settings are rafts and infill. Rafts are useful if your print has a small base size. They create a larger base layer so the print adheres well to the build plate. You can use infill to determine how much material is used in the interior of your print and these options can be controlled via the software your printer comes with. There is software available for advanced users, notably Simplify 3D, although this most likely won't be necessary for 3D printing at libraries.

Can you offer any best practices for finishing prints?

If you are having issues removing your prints from the printer, you can use a hack of applying hairspray to the build plate before the print. Should you want a more "official" way to go about this, the BuildTak sheet mentioned earlier is one of the most trusted options for 3D printer users.



© 2016 American Library Association. This work is licensed under a Creative Commons Attribution License, available at <http://creativecommons.org/licenses/by/3.0/>.

Acknowledgments

The authors thank Michael Weinberg and Jason Griffey for their advice, and Olga M. Zhivov for her design work.

About the Authors

Zach Lichaa runs 3DPrint360, a New York based company dedicated to serving newcomers to 3D printing and enthusiasts with advice and reliable products. His work with 3D Hubs and other 3D printing entities in the United States, Europe and Asia has helped bring additive manufacturing into the general public.

Charlie Wapner is the Senior Information Policy Analyst for ALA's Office for Information Technology Policy. In this capacity, he leads ALA's policy work on 3D printing, and also works on telecommunications, intellectual property and digital content issues. In addition to this document, Charlie has written several other ALA publications on 3D printing. These include a [tip sheet](#) on 3D printing and public policy – with the Public Library Association and United for Libraries – a [white paper](#) on the policy and economic implications of 3D printing, and a [paper](#) calling policymakers' attention to libraries as 3D printing leaders.