## Option B – 3D Printing

3D printing is any process by which actual physical object is built up through an automated process. That “process” is also called “additive manufacturing” because 3D printing adds on material layer by layer over time, thus building up an object where there was not any starting material beforehand.

The most common form of consumer 3D printers is of the FDM type. FDM stands for Fused Deposition Modeling, or is also called sometimes Fused Filament Fabrication, of FFF for short. They both mean the same thing. This type of printer is a high-tech version of a hot glue gun. A thin strand of material feeds into the 3D printer, gets heated up until it starts to melt by a small heater, the material flows out of a small nozzle, and gets deposited onto a build plate one layer at a time. This material is a “filament,” which is just a description of the shape of the material that goes into the printer, and not any specific type of material. After one layer is printed, the nozzle moves up and proceeds to “draw” another layer, so on and so forth until the entire model is created. These represent very roughly about 90% of the market for consumer printers.

The second type of consumer 3D printer, representing about 10% of the consumer market, is called the SLA printer segment. SLA stands for Stereolithographic Apparatus and is a way of saying “stereo” for light, “litho” for writing, and apparatus as a mechanical gizmo. These printers also create models’ layer by layer, but they do so by using a photo-sensitive resin that, when hit by a bright light, cures into a solid form. So, the printer will shine a pattern on a thin layer of resin that is next to a build plate and harden it, and then the plate will move up and the printer will shine another layer, and this process repeats until a model appears out of hundreds of thousands of cured layers of resin. There are tons of advantages to printing this way, but also some notable disadvantages, and things to consider when looking into SLA.

All 3D printers need a 3D model in order to print. That 3D model is created on a computer and is something you can rotate around and look at from all angles. When you talk about 3D models and 3D printing, the STL file format is the most common file format for 3D printing. STL stands for Standard Tessellation Language and is the lowest common denominator for all 3D printers. This file format cannot hold any color information for color 3D printing, it does not have any built-in error checking, but it is usable for all 3D printers on the market. All the STL file format does is define points in space. When you have points in 3D space and connect each point to the next closest point you get triangles. You can create STL files from just about any 3D program out there.

### Exercise – Terms and History

Terms that are connected to the correct manufacturing type:

* 3D Printing:
  + Additive Manufacturing
  + Filament, Resin, & Powder
  + Complexity is free
  + Mass customization
  + RepRap Project
* Traditional Manufacturing
  + Subtractive Manufacturing
  + Drilling bits
  + More complexity, higher cost
  + Mass production

### Exercise – 3D Printing Technologies

SLA

* Which type of material is used in SLA printers?
  + Resin
* What is the approximate resolution?
  + 25-100 Microns
* How does an SLA printer work?
  + Uses lasers to trace out layers in material
* Who are they commonly used by?
  + Consumers
* What concern should you be aware of when using an SLA printer?
  + Room temperature can affect the print quality

FDM

* Which type of material is used in FDM printers?
  + Filament
* What is the approximate resolution?
  + 100-300 Microns
* How does an FMD printer work?
  + Extruding heated material, layer by layer
* Who are they commonly used by?
  + Consumers
* What concern should you be aware of when using an SLA printer?
  + Visible layers on models

SLS

* Which type of material is used in SLS printers?
  + Powder
* What is the approximate resolution?
  + Less than 25 Microns
* How does an SLS printer work?
  + Using lasers to project each layer in material
* Who are they commonly used by?
  + Online service bureaus
* What concern should you be aware of when using an SLS printer?
  + Requires a ventilation system

### Exercise – 3D printing Software

Which software offers a simple way to capture a 3D model of an existing object, using photography?

* 123D Catch

Which software is a good choice for beginners who’d like to start out by combining simple shapes to create a design?

* Thinkercad

Which software is best for someone who’d like a more advanced tool to design precision parts for production?

* Fusion 360

Which software has a wide array of sculpting tools, and can be used to prepare an STL file for printing?

* Meshmixer