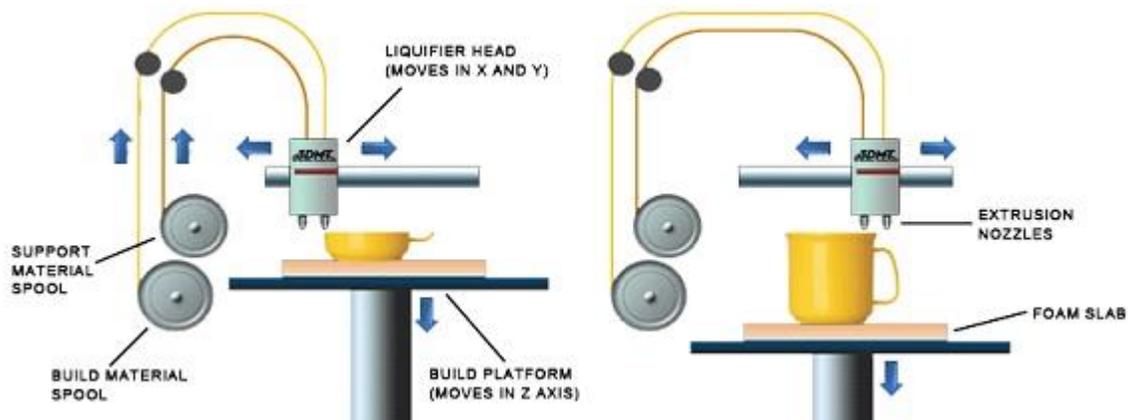


Fused Deposition Modeling (FDM / FFF):

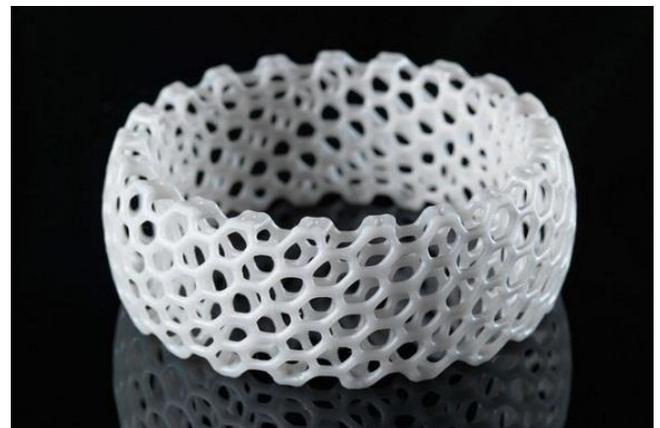
Fused deposition modeling (FDM) technology was developed and implemented at first time by Scott Crump, Stratasys Ltd. founder, in 1980s. Other 3D printing companies have adopted similar technologies but under different names. A well-known nowadays company MakerBot coined a nearly identical technology known as Fused Filament Fabrication (FFF).

With help of FDM you can print not only functional prototypes, but also concept models and final end-use products. What is good about this technology that all parts printed with FDM can go in high-performance and engineering-grade thermoplastic, which is very beneficial for mechanic engineers and manufactures. FDM is the only 3D printing technology that builds parts with production-grade thermoplastics, so things printed are of excellent mechanical, thermal and chemical qualities.



3D printing machines that use FDM Technology build objects layer by layer from the very bottom up by heating and extruding thermoplastic filament. The whole process is a bit similar to stereolithography. Firstly special software “cuts” CAD model into layers and calculates the way printer’s extruder would build each layer. Along to thermoplastic a printer can extrude support materials as well. Then the printer heats thermoplastic till its melting point and extrudes it throughout nozzle onto base, that can also be called a build platform or a table, along the calculated path. A computer of the 3d printer translates the dimensions of an object into X, Y and Z coordinates and controls that the nozzle and the base follow calculated path during printing. To support upper layer the printer may place underneath special material that can be dissolved after printing is completed.

When the thin layer of plastic binds to the layer beneath it, it cools down and hardens. Once the layer is finished, the base is lowered to start building of the next layer. Printing time depends on size and



complexity of an object printed. Small objects can be completed relatively quickly while bigger or more complex parts require more time. Comparing to stereolithography this technique is slower in processing. When printing is completed support materials can easily be removed either by placing an object into a water and detergent solution or snapping the support material off by hand. Then objects can also be milled, painted or plated afterwards.



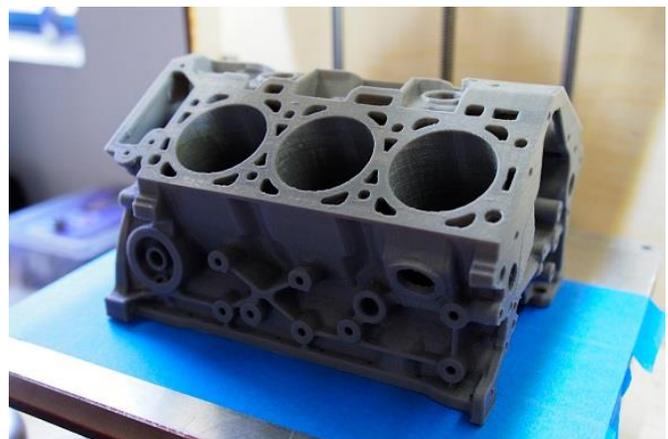
FDM technology is widely spread nowadays in variety of industries such as automobile companies like Hyundai and BMW or food companies like Nestle and Dial. FDM is used for new product development, model concept and prototyping and even in manufacturing development. This technology is considered to be simple-to-use and environment-friendly. With use of this 3d printing method it became possible to build objects with complex geometries and cavities.

Different kind of thermoplastic can be used to print parts. The most common of those are ABS (acrylonitrile butadiene styrene) and PC (polycarbonate) filaments. There are also several types of support materials including water-soluble wax or PPSF (polyphenylsulfone).

Pieces printed using this technology have very good quality of heat and mechanical resistance that allows to use printed pieces for testing of prototypes. FDM is widely useful to produce end-use products, particularly small, detailed parts and specialized manufacturing tools. Some thermoplastics can even be used in food and drug packaging, making FDM a popular 3D printing method within the medical industry.

The price for those 3D printers depends on size and model. Professional ones usually cost from \$10,000 and more. 3D Printers designed for home use are not so expensive. There are several models like Replicator of MakerBot, Mojo of Stratasys and Cube of 3D Systems. The price for these models varies from \$1,200 to \$10,000. However, new start-ups offer more and more affordable versions of FDM 3D printers, the price of which can be just about \$300-\$400.

Also there are many fans of 3D printing or DIY'ers that prefer to create their own 3D printers from the very scratch. There are websites that offer big variety of DIY kits and parts for RepRap printers. For more information please refer to the following article where you can find basic things about how to build 3d printers from scratch.



<http://3dprintingfromscratch.com/common/types-of-3d-printers-or-3d-printing-technologies-overview/>