



Additive

Additive Manufacturing: How it Begins

Additive manufacturing is done through several unique technologies but each additive process begins the same way

Additive Manufacturing: How it Begins

1. A CAD file with a specific geometry is converted to a surface tessellation (STL) file
2. This file is transferred to the additive manufacturing system for building
3. The geometry is divided into horizontal slices of varying thicknesses

A Brief History of Additive



The first successful attempts at additive manufacturing came from technology developed in the 1970s, though additive's earliest roots can be traced to topography and photosculpture, both first developed in the 1800s.

Additive technology developed rapidly throughout the 1980s and 1990s, and it has seen increasing industrial applications in the last 20 years.

The Advantages of Additive

Speed:

Without the need for molds or dies, additive allows you to make parts and prototypes on demand



The Advantages of Additive

Cost:

No need to build a mold and design changes can be made without adding cost



The Advantages of Additive

Design freedom:

Design changes can be made quickly and easily; constraints on tooling and machining are eliminated



The Advantages of Additive

A large, complex, white, 3D-printed lattice structure, possibly a mechanical part or a decorative object, shown in a close-up view. The structure is composed of many interconnected, repeating geometric units, creating a porous, honeycomb-like appearance. The units are arranged in a way that creates a series of vertical channels and horizontal layers, giving it a sense of depth and complexity. The material appears to be a smooth, slightly translucent plastic or resin. The background is a plain, light-colored surface.

Convenience:

Design and production can all take place in-house, on your schedule

Stereolithography

- Stereolithography uses a combination of photochemistry and laser technology to build parts in photopolymer resins
- Each part is built in layers, and a UV laser traces the 2D section onto photopolymer resin surface
- The build surface is lowered into the resin vat, the resulting layer of resin is once again exposed to the laser



Fused deposition modeling

- FDM uses a plastic filament or metal wire that is unwound as it supplies material to an extrusion nozzle
- The nozzle is heated to melt the material as its movement is controlled by CAM software
- The material hardens immediately upon extrusion from the nozzle



Image courtesy of Stratasys

3-D printing

- 3-D printers make parts and assemblies in similar fashion to a standard inkjet printer. It spreads layers of plaster or resin powder, then binds them together
- Can produce parts made of several materials with different mechanical and physical properties in a single build process
- It's faster, more affordable and easier to use than other additive technologies
- It's the only method in the world that can produce a full-color object



Laser Sintering

- Uses a high power laser to fuse plastic, metal, ceramic or glass powders in cross section
- A new layer of powder is added to from each cross section
- Unfused powder acts as support during the build



Laser Engineered Net Shaping

- Uses four nozzles to make parts from inside out: Nozzles direct stream of metal powder in argon gas while high-powered laser beam
- Nozzles direct a stream of metal powder in argon gas toward a moveable center point
- High-powered laser heats the center point
- Can go from raw materials directly to metal parts
- Can be used on an array of alloys



Emerging Uses of Additive Processes

- Development of superalloy additive manufacturing for nickel superalloy jet engine part features
- Direct Laser Sintering of titanium for aerospace components
- Repair of heat-treated steels and components

“Manufacturing for the Masses”

A group of people in a classroom or office setting, looking at a tablet and discussing it. The background is a blurred image of a group of people, including a woman in a white lab coat, a man in a vest, and a woman with long dark hair, all looking at a tablet. The scene is brightly lit, suggesting a modern, collaborative work environment.

Advantages of 3D printing

- It is relatively affordable
- Ease of use means it can be brought to the classroom, office, and even the home
- Several open-source projects have been developed to encourage broader use of the technology outside the traditional manufacturing world

RepRap

- RepRap is a community-based project to help people build their own 3-D printers
- Designs for the printers are released under an open-source license
- Printer can be used to make a variety of common objects, and can be used to make another 3-D printer
- Learn more about the project at <http://reprap.org>



MakerBot Industries

“It’s your own little factory.”

- MakerBot produces several open-source 3-D printers, which print with ABS plastic
- Build-it-yourself machines include CupCake CNC, “the cutest rapid prototyping machine ever,” as well as the Plastruder MK3, a plastic extrusion machine
- Learn more at <http://makerbot.com>



FAB@HOME

- Fab@Home is an open-source, mass collaboration personal fabricator project
- The goal: bringing personal fabrication to the home
- Includes downloadable printer designs, with an online forum, to assist people in building their own personal fabricators
- Learn more at <http://fabathome.org>



FAB@HOME

The Future: “On-Demand” Manufacturing

Additive technology is an important component of realizing the concept of “on-demand manufacturing.”

The goal:

- improve output volume
- reduce unit cost
- improve quality control
- minimize the cost and lead time associated with tooling work

It's the next step in manufacturing technology, with the potential to revolutionize the industry as it currently stands.