

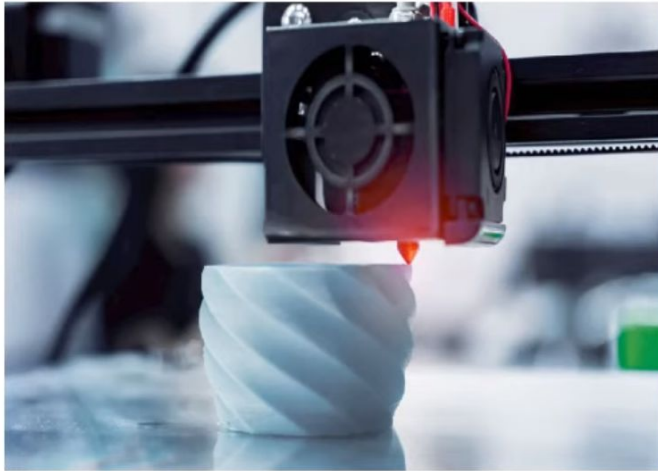


Additive Technology (CAD, 3D Printing)

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Additive Manufacturing

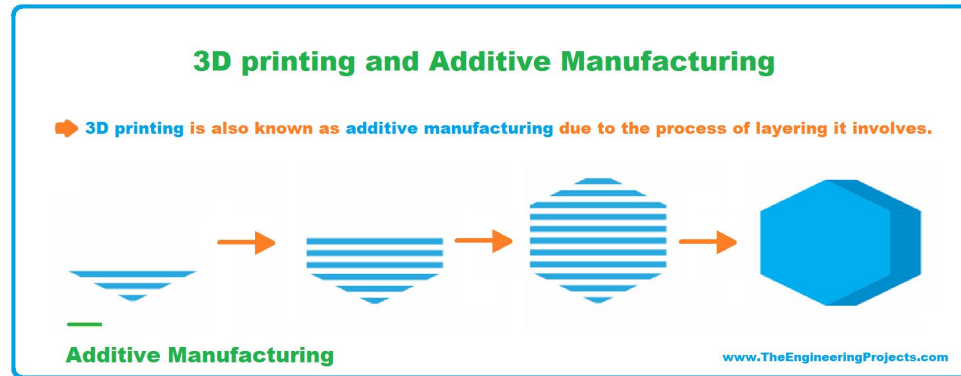
Its a computer controlled process that creates three dimensional objects by depositing materials, usually in layers.



It is also known as 3D printing

Definition of 3D Printing or Additive Manufacturing

- A 3D object can be defined as, "An object or structure that has three dimensions which includes width, length, and height."
- 3D printing can be defined as; "Structuring a three-dimensional object in its physical configuration from its digital form"
- 3D printing is also known as additive manufacturing due to the process of layering it involves. Both terms are used synonymously, digital printing is another term used for this purpose which you might have heard as well.



- ❑ Additive manufacturing is the opposite of subtractive manufacturing which was used widely in the past involving gradual removal of layers from a solid block of any material either be wood or metal to form a 3D object.
- ❑ Additive manufacturing as the name indicates is the layer by layer deposition of a specific material to form a 3D shape or structure.
- ❑ This technique can be employed in powders be it glass, ceramic, metal and resins in liquid form.

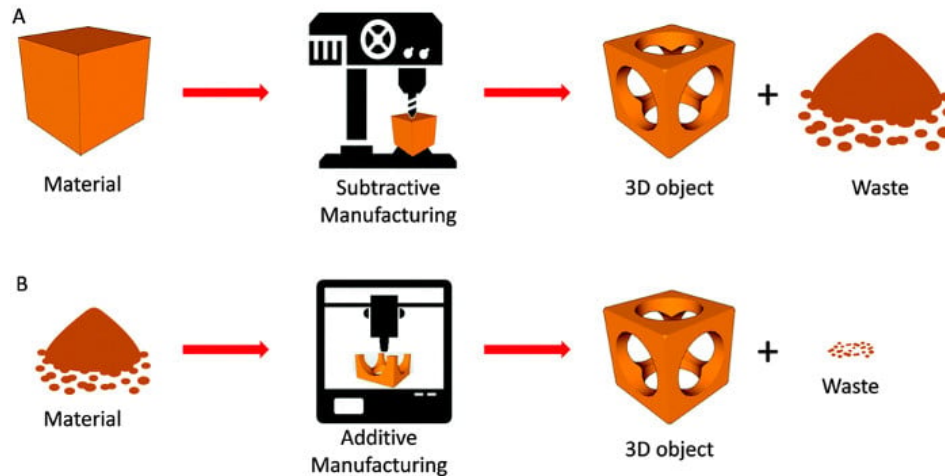


Figure. Subtractive manufacturing versus Additive manufacturing

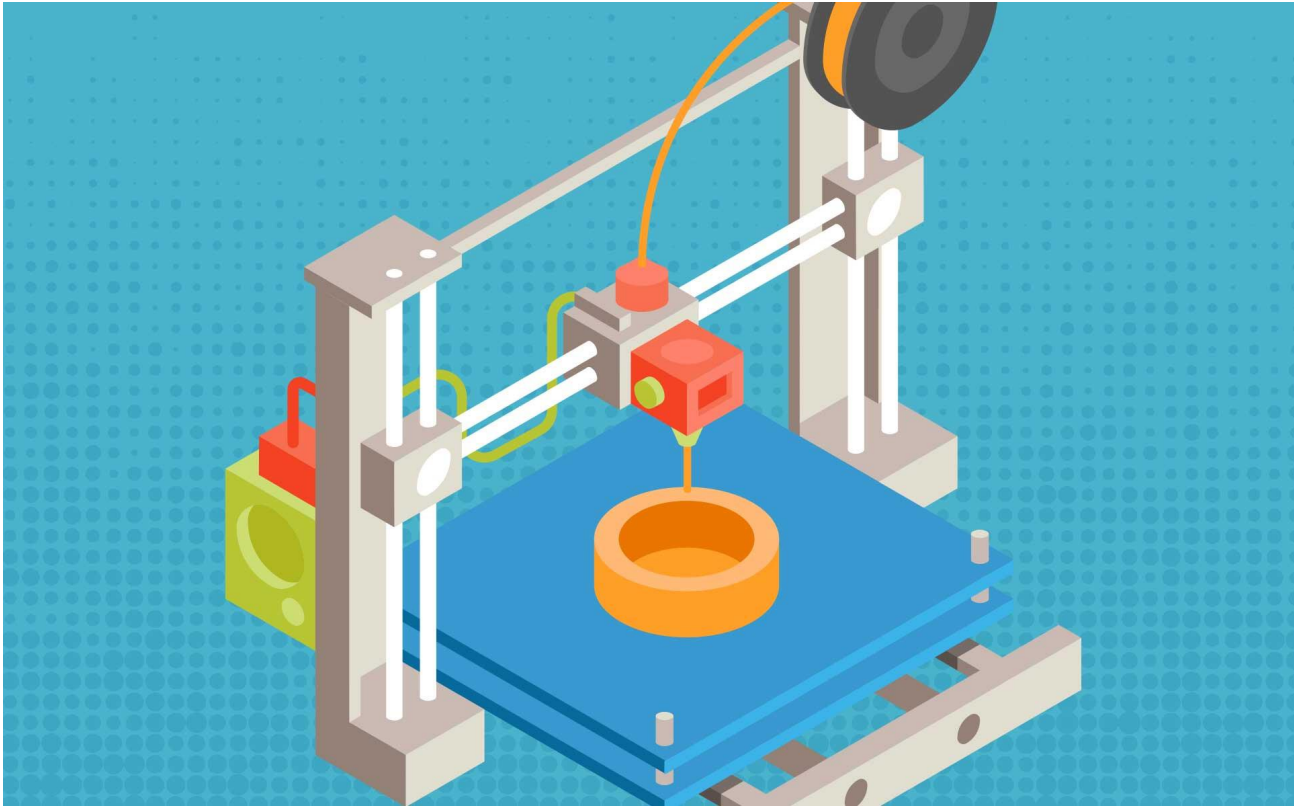



Figure. 3D Printer Systems


What is Additive Manufacturing?

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- A horizontal decorative bar with a teal segment on the left and an orange segment on the right.
- Additive Manufacturing (AM) is an appropriate name to describe the technologies that build 3D objects by adding layer-upon-layer of material, whether the material is plastic, metal, concrete.
 - In additive manufacturing (AM), material is applied layer by layer in precise geometric shapes based on a CAD model. In contrast, conventional manufacturing processes typically involve milling or otherwise removing material to create an object.
 - Additive manufacturing refers to the general manufacturing process - the production of objects by adding material - under which various production processes such as rapid prototyping, rapid tooling or mass customization.
 - Additive manufacturing offers significant benefits to a wide range of industries, whether it's the ability for agile product customization, functional integration, or rapid and cost-effective spare parts procurement.
 - Complex shapes and design elements can be easily cured on the materials using additive manufacturing techniques.

- NIST: ‘Additive manufacturing fabricates parts by building them up layer-by-layer, as opposed to cutting material away or molding it’.
- Additive manufacturing can also be viewed as a way to turn a digital model (*of the object to be constructed*) into a physical one since it starts as a (3D) software design.

Additive Manufacturing in Industry 4.0

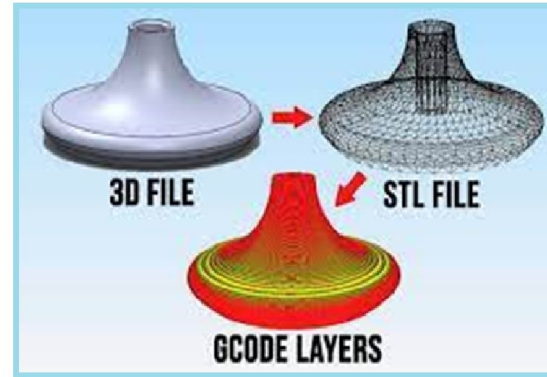
- The latest industrial revolution, Industry 4.0, is encouraging the integration of intelligent production systems and advanced information technologies. Additive manufacturing (AM) is considered to be an essential ingredient in this new movement.
- Industry 4.0 promotes the integration of smart technologies and production systems through AM.
- Compared to subtractive processes like milling, additive manufacturing generally provides greater geometric freedoms and utilizes less material in Industry 4.0. In contrast to forming processes such as injection molding or composites layup, 3D printing does not require a mold or other tooling to create a part.
- Additive Manufacturing Technology like 3D printers has provided companies with the ability to rapidly prototype and produce high-performance, customized products. Additive manufacturing reduces build times and creates a more durable product.
- Additionally, additive manufacturing allows developers to incorporate complex designs and features without increasing cost.

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- A horizontal decorative bar with a teal segment on the left and an orange segment on the right.
- With Industry 4.0, additive-manufacturing methods will be widely used to produce small batches of customized products that offer construction advantages, such as complex, lightweight designs.
 - High-performance, decentralized additive manufacturing systems will reduce transport distances and stock on hand. The production should be faster and cheaper with the use of additive manufacturing technologies.
 - As the needs of customer is changing continuously the challenge of increasing individualization of products and reducing time to market are faced by many companies.

- A few basic processes that are involved in 3D printing which are: -
 1. **Modeling:** 3D printing begins with the process of designing the product in digital form using software like AutoCAD, solid works, etc.
 2. **STL File Format:** STL file format is mostly used in Stereolithography. It is also called Standard Tessellation Language or Standard Triangle Language STL file format is used for describing the surface geometry of an object to be printed by the 3D printer before the process starts.
 3. **3D Slicing:** 3D slicing is the process of breaking down a design into several layers. A slicer generates a G code which helps in providing instructions to the 3D printer that is how the print process should be carried out.

3D Slicing

➡ **3D slicing** is the process of breaking down a design into several layers.

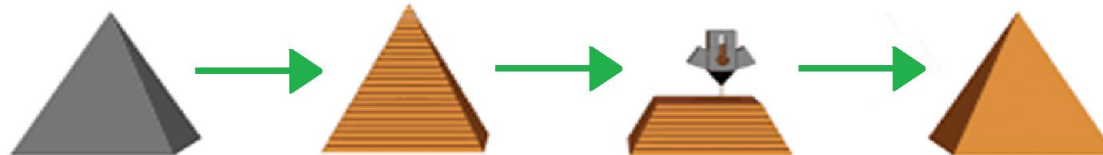


3D CAD FILE
.STL file format

CAM - SLICIGN
.GCODE file format

3D Printing

FINAL - PHYSICAL OBJECT



Process of 3D Printing

The basic working principle of additive manufacturing

- AM technologies are made up of five basic steps: -
 1. The first step is the generation of three-dimensional (3D) geometric modeling of the components to be made in AutoCAD, Pro/E, Catia, Solid work, or using any other CAD software.
 2. After the creation of the digital CAD model, the second step is the conversion of the CAD file to the additive manufacturing file (AMF) format or a standard triangulation language (STL) file. These are the standard input file formats accepted by any AM machine. The STL file format is the representation of the CAD model by a series of triangles.
 3. The third step is the slicing process of the STL or AMF files. Before the slicing process is commenced, the part orientation is optimized for the building process based on various optimization parameters, which include the ease of building with no or minimal support structure and minimum building time.
 4. The fourth step is the actual component building process.
 5. The fifth step is the removal of the component from the
 6. build platform when the building process is completed. In this step, the support structures are removed, the part is cleaned up.

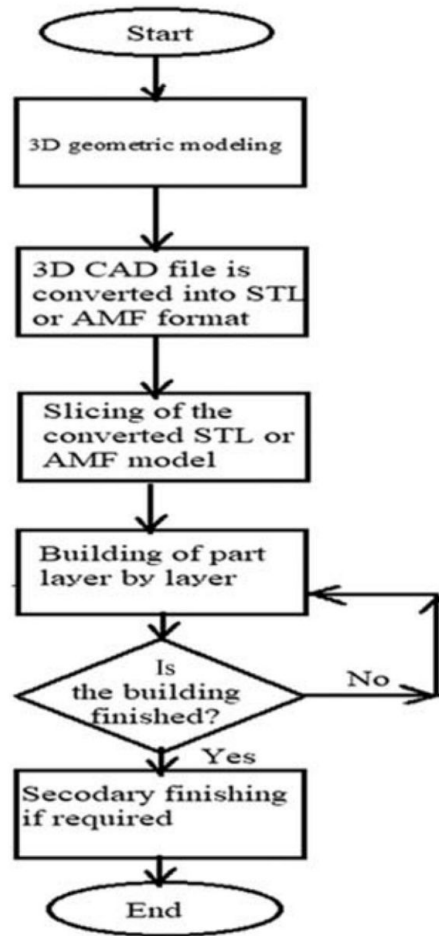


Figure. Schematic diagram of the basic principle of additive manufacturing technology

Advantages of Additive Manufacturing

- 3D printing first gained traction as a tool for rapid prototyping, but as the technology has advanced, there are now numerous advantages to choosing additive manufacturing for production. Here are some of them:
 - Design freedom
 - Material options
 - Lightweighting
 - Speed
 - Less waste
 - Cost savings
 - On-Demand Production

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- A horizontal bar with a teal left half and an orange right half is positioned above the list.
- ☐ Medical Equipment
 - ☐ Toys And Games
 - ☐ Assembly Parts
 - ☐ Art and Design
 - ☐ Jewellery
 - ☐ Automotive Industry
 - ☐ Architectural Designs

Resources

- https://www.google.com/search?q=additive+technology&oq=additive+technology&aqs=chrome..69i57j0i512l3j0i22i30l6.7657j0j7&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:217dcac2,vid:URUC6-nkL_CM,st:0
- https://www.google.com/search?q=additive+technology&oq=additive+technology&aqs=chrome..69i57j0i512l3j0i22i30l6.7657j0j7&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:3d902fdf,vid:EHvO-MlzA_IM,st:0