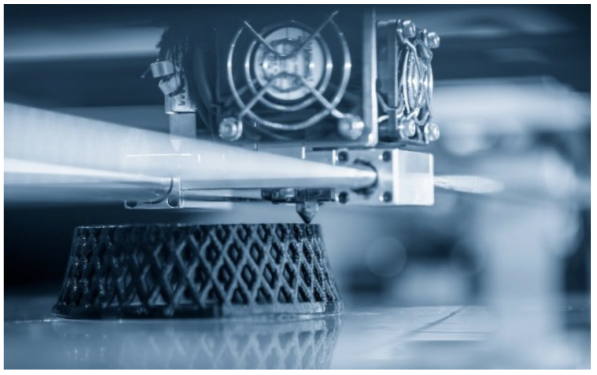
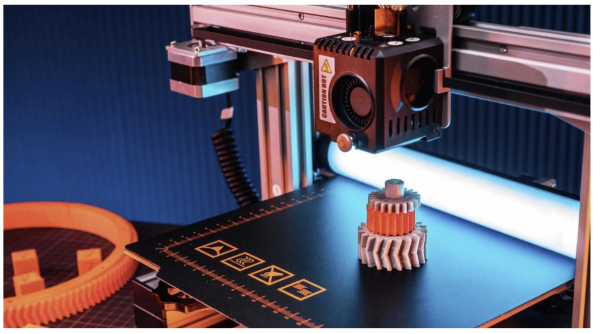
# 3D Printing, Yay!! or Nay!!

## So, What is 3D printing?

Additive manufacturing, also known as 3D printing, is the technique for producing three-dimensional items from a computer file by depositing material layer by layer.



## And, Why 3D Printing



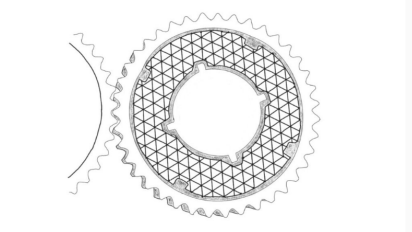
It allows for the development of complicated and specialized items with excellent precision and efficiency.

# ADDITIVE MANUFACTURING FOR GEARING MECHANISM

## What Makes It So Desirable?

+ Design Flexibility

Complex design, which are almost unable to be manufactured with the traditional way, aka subtractive manufacturing can be easily produced using Additive manufacturing. Using 3D printing, complex internal structure, curvings or overhangs can be developed easily.



DRAWN DIGITALLY WITH SAMSUNG S6 LITE

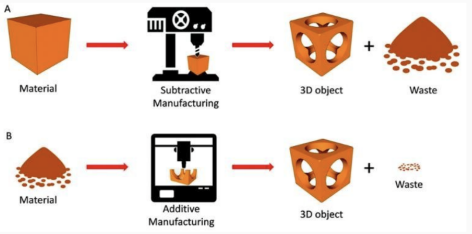
+ Rapid Prototyping

It saves the time for the manufacturing of moulds and other manufacturing tools used in conventional

production processes like Injection moulding, extrusion etc. The pre-processing step in AM require far less time. The space required for the installation of machinery is also very minimal in comparison to other processes.

+ Material Efficiency

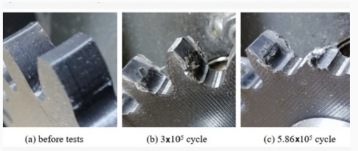
The additive manufacturing process is also helpful to increase the material efficiency significantly. Only the necessary material required for the production is used, sometimes support materials are also used. But in comparison to traditional manufacturing, the material saving is significantly higher.




# Exploring The Limitations

- Reduced material options:

One of the primary downsides of additive manufacturing is that the materials that may be utilized are generally limited. This is especially difficult for gears, which must be composed of materials that are robust, sturdy, and resistant to wear and strain. While certain high-strength materials are available for use in additive printing, the options are still restricted when compared to traditional production processes.

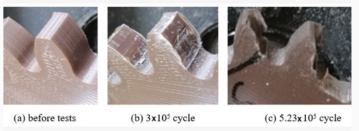


SERVICE LIFE OF GEAR FABRICATED OF PLA

- Reduced strength compared to conventionally built gears:

Another downside of additively created gears is that they may be less strong than conventionally constructed gears. This is due to the fact that the additive manufacturing process can result in microstructural flaws and residual stresses, both of which can weaken the material.

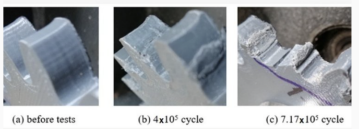
In an experiment conducted, a 1.5 Nm load was applied to the gear pair and the system was rotated at 900 rpm. To determine the service life of the test gears, they were run at the same load and rotational speeds until the gears were damaged. In order to observe the wear in polymeric gears, a St 37-2 steel gear was used as the driven gear.



SERVICE LIFE OF GEAR FABRICATED OF ABS

- Additional post-processing processes required:

Many additive manufacturing processed gears require extra post-processing procedures to provide the required surface smoothness, tolerances, and strength. This can involve heat treatment, machining, and other finishing procedures, all of which add time and expense to the manufacturing process.



SERVICE LIFE OF GEAR FABRICATED OF PETG

- Surface roughness:

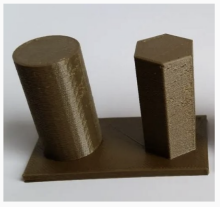
As compared to traditionally manufactured gears, additively generated gears may have rougher surface finishes, mostly “steps” which are due to layering, which can impair performance and longevity. Further post-processing can improve surface roughness, but this increases manufacturing time and expense.

# Overcoming the Limitations

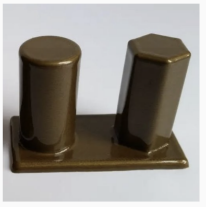
One of the biggest downsides of additive manufacturing is the limited material choices. Metals, polymers, and ceramics are among the materials available for traditional manufacturing procedures. Yet, the materials accessible in additive manufacturing are usually more restricted. To overcome this, scientists are creating new materials particularly suited for additive manufacturing. Metal powder alloys, for example, are being produced with increased characteristics and ease of processing. Moreover, new materials such as ceramics, polymers, and composites are being investigated, which may broaden the spectrum of materials accessible for additive manufacturing.

Additive manufactured products could be weaker than traditionally produced ones. This is due to the fact that the additive manufacturing process can result in microstructural flaws and residual stresses, both of which can weaken the material. A adjusting process factors like as laser power, scanning speed, and powder bed temperature to increase the robustness of additive produced components can be helpful. It is possible to limit the occurrence of flaws and residual stresses in the material by optimizing these characteristics, which can increase its strength and durability.

Another challenge with additive manufacturing is surface smoothness, particularly with gears, which require a flat surface to function correctly. Which can be optimized using post processing, This can include heat treatment, machining, and other finishing processes. post processing is an effective way to achieve the desired surface quality.



SURFACE ROUGNESS OF 3D PRINTED BLOCK



AFTER POST PROCESSING

# Is additive manufacturing the right choice for you?

The specific application, the needed specifications of the item, the volume of production, and the available resources all play a role in determining if additive manufacturing is the best choice.

You can ask yourself these questions,

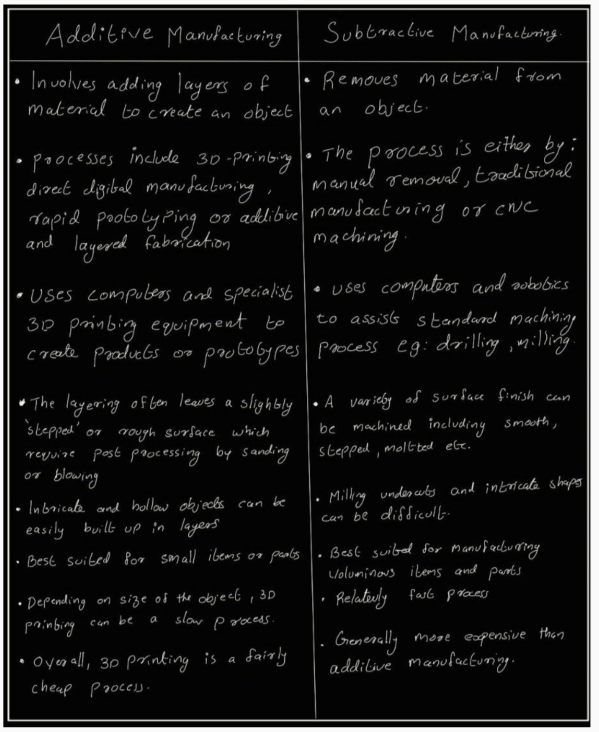
1. Does your product have complex geometry?
2. Are you mass producing the item or on a small scale?
3. Will your product require constant reconfiguration?

Read Below To Find Out!!

Traditional manufacturing processes, on the other hand, may be a better alternative for high-volume production runs or products that require exact tolerances or specialized material qualities. This is due to the fact that additive manufacturing is still in its early stages and may not yet be capable of making parts with the needed accuracy and strength. Moreover, the cost of additive printing materials and equipment might be prohibitively expensive for big production runs.

Additive manufacturing is a great means of producing items with complicated geometries, customisation needs, and low-volume production runs. In certain cases, the cost savings, decreased waste, and faster prototyping afforded by additive manufacturing may offset the technology's drawbacks.

Here's a Basic comparison of Additive Manufacturing and Subtractive Manufacturing



| Additive Manufacturing | Subtractive Manufacturing |
| --- | --- |
| • Involves adding layers of material to create an object | • Removes material from an object. |
| • Processes include 3D-printing direct digital manufacturing, rapid prototyping or additive and layered fabrication | • The process is either by: manual removal, traditional manufacturing or CNC machining. |
| • Uses computers and specialist 3D printing equipment to create products or prototypes | • Uses computers and robotics to assist standard machining process eg: drilling, milling. |
| • The layering often leaves a slightly 'stepped' or rough surface which require post processing by sanding or blowing | • A variety of surface finish can be machined including smooth, stepped, moltted etc. |
| • Intricate and hollow objects can be easily built up in layers | • Milling undercuts and intricate shapes can be difficult. |
| • Best suited for small items or parts | • Best suited for manufacturing voluminous items and parts |
| • Depending on size of the object, 3D printing can be a slow process. | • Relatively fast process |
| • Overall, 3D printing is a fairly cheap process. | • Generally more expensive than additive manufacturing. |

# Closing and Conclusion

Additive manufacturing is a fast emerging technology with tremendous future application possibilities. It has already revolutionized various industries, including medical, aerospace, and automotive, by allowing for greater design flexibility, decreased waste, and shorter manufacturing times. Additive manufacturing might potentially be used to create more complicated components and structures like organs and tissues, as well as complete buildings. Furthermore, the technology might be used with robots and automation to allow for quicker and more effective manufacturing processes. Overall, the future of additive manufacturing is broad and promising.

For gears, additive manufacturing could be the future, But it would take more advancement in the area to make it happen. For now, for mass production, Traditional manufacturing have advantage over Additive manufacturing. For light weight application such as aerospace sector, 3D printing have made possible things that were only imaginable.