White Paper

on

3D Printing Technology in Aerospace and Automotive Industry

Abstract:

3D printing is a fourth industry revolution, which delivers potential in the engineering sector. This paper presents framework in selecting/adopting additive manufacturing for Automotive and Aerospace sectors.

Introduction:

3D Printing is also known as rapid manufacturing, digital manufacturing, direct digital manufacturing, and rapid prototyping. This method extends the current concept of creation and enables several manufacturers to create objects from conception and design to physical creation.

3D printing is a technology that is growing at a rapid pace as the technology positively influences manufacturing processes and help deliver high level of business performance. 3D printing is alternate and a better choice to traditional manufacturing process. A production line that is set up for 3D printing is easier to alter than that of a production line for traditional manufacturing, making 3D printing a feasible option for many reasons. The primary advantage of adopting 3D printing is that businesses need only .STL file for production.

The evolution of 3D printing has seen a rapid growth in the number of companies adopting the technology. The applications and use cases vary across all industries.

3D Printing Technologies and Processes:

Different types of 3D printers available based on printing process.

Sl. No	Technology	Medium	Materials
1	Fused Deposition Modeling (FDM)	Nozzle	Plastics
2	Material Jetting (MJ)	Ink Jet	
3	Selective Laser sintering (SLS)	Laser	
4	Digital Light Processing (DLP)	UV Light	Metal
5	Selective Laser Melting (SLM)	Laser	
6	Electronic Beam Melting (EBM)	Electron Beam	
7	Laminated Object Manufacturing (LOM)	Laser	
8	Electron Beam Additive manufacturing (EBAM)	Electron Beam	
9	Direct Metal Laser Sintering (DMLS)	Laser	

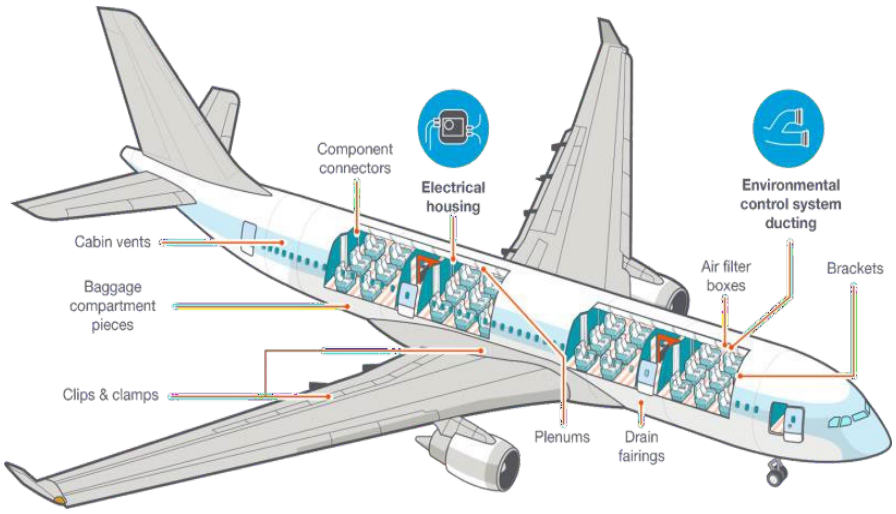
Process:

3D printing is a way of creating three dimensional (3D) solid objects. The printing is done by building up the object layer by layer. These types of printers usually utilize the plastic material as it is easier to use and material comes at a relatively low-cost. There are various 3D printers that can also 3D print with other materials, such as metals and ceramics. The set up of 3D printing production line is easier than of traditional manufacturing, making 3D printing a feasible and a better option.

3D Printing Industrial Applications:

Aerospace:

The Aerospace industry has a high and early rate of adoption of most of the technologies in the current generation. Both aircraft as well as engine manufacturers have been relying on 3D printing technology in order to develop lightweight parts to gain efficiency.



The Aerospace 3D printing market is projected to grow from USD 714.5 in 2017 to USD 3,057.9 million by 2022. The market for Aerospace 3D printing is gaining traction and expanding to various regions including Asia, North America, Europe, South America, and Middle East & Africa. Among these regions, North America is the largest market of Aerospace 3D printing. The growth of North America market is attributed to high adoption rate of 3D printing technology in the aerospace industry. The presence of regional and leading players in the region backed by approval from Federal Aviation Administration (FAA) for the use of 3D printed parts in commercial aircraft is driving the market.

The Aerospace industry currently accounts for a share of 16.8% of the 3D printing market and is likely to grow at a rapid rate in years to come, generating huge growth opportunities for the market participants.

Objective 1: Air Ducts

3D Printing material: ULTEM (Polyetherimide)

Ultem (polyetherimide) is a semi-transparent high strength plastic material that can operate in high service temperature environments. Ultem is resistant to hot water and steam that can withstand repeated cycles.

Objective 2: Wiper and Wiper Mechanism

3D Printing Material: ABS Plastic

Acrylonitrile Butadiene Styrene (ABS) is lightweight and has good impact strength; it is abrasion resistant and affordable. Moreover, ABS polymers withstand a lot of chemical formulas. The glass transition temperature of ABS plastic is 105°C (221°). ABS plastic and 3D FDM/FFF printers are a popular combination for many applications. The physical properties of this type of plastic, like its impact resistance, tensile strength and stiffness, and its heat deflection temperature are real advantages. It can also be used for mechanical purposes, or for its electrical properties.

Aerospace applications:

- Ducts
- Vents
- Support Brackets
- Door Latch Components
- Seat End and Arm Rest Caps
- Cable Management
- Electrical Housings and many more

Cable Management

Interiors

Automotive:

The Automotive industry has experienced an unique, industry wide adoption of 3D printing as a manufacturing technique since its early days. It is no surprise that automotive manufacturers are among one of the most promised to find new applications and develop the technology further. After all, 3D printing is a game changer for the sector and the tendency is the consolidation of additive manufacturing throughout all its segments.

The global automotive 3D printing market size was valued at $762 Million in 2016, and is projected to garner at $2,730 Million by 2023, growing at a CAGR of 19.7% from 2017 to 2023. Additive printing technology or 3D printing allows manufacturers to build models using a variety of printing materials. Though 3D printing technology is in its nascent stage in the automotive sector, the automotive 3D printing market is expected to gain traction in the coming years.

Additive manufacturing enables companies to create complex designs that require fewer parts to produce these components. Consequently, companies are able to decrease the assembly time and also experience a reduction in quality problems.

The additive manufactured part was 64% lighter and it was still as strong as its counterpart, without any deterioration in performance. The added advantage of AM is that it enables companies to be less dependent on tooling and casting since it allows for the creation of prototypes that do not require either of them. Developing and creating a prototype for an engine manifold with traditional manufacturing can take up to four months and cost around half a million dollars. However, with 3D printing, the company was able to develop several iterations in only 4 days and 99.4% cheaper, only $3000

Objective 1: Vehicle Dashboard

3D printing Material: ABS+PC Plastic

Dashboard is a control panel usually located ahead of the driving seat, displaying instrumentation and controls for the vehicle's operation. ABS is lightweight and has good impact strength. ABS shows excellent mechanical properties. ABS is hard and tough in nature and delivers good impact strength. PC offers accuracy, durability and stability, creating strong parts that withstand functional testing. PC has superior mechanical properties to ABS and a number of other thermoplastics. AM helps in manufacturing customized dashboard design as per customer requirement.

Objective 2: Functional Mounting Brackets

3D printing Material: Nylon or Titanium

AM allows organic shapes and designs to be manufactured but AM also requires very little input from an operator that enables engineers to quickly take a design from a computer to assemble in a very short amount of time. This is not possible with traditional manufacturing techniques like CNC machining, where a highly skilled machine operator is needed to produce parts. Powder bed fusion technologies like SLS nylon and metal (Titanium) printing are best suited for functional parts and offer a range of materials.

Automotive Applications:

- Mounting Brackets
- Interior accessories
  - Mirrors
  - Air Ducts
  - Bumper
  - Lights
  - Hand Brake
  - Steering

Interiors

Hand Gear

Benefits on 3D Printing:

Tools Customization:

The production line of automotive vehicles heavily depends on tooling for assembling and manufacturing high-quality products with consistency. Additive manufacturing allows automotive companies to customize car assemble tools by improving its functionality and educing its weight at a lower cost than traditional manufactured tools. There are even cases, where completely new tools are developed for specific or customized designs.

Reducing Tooling Costs:

Automotive OEMs prepare tooling and investment castings for a specific component during the design phase of a new product. As the preparation of tooling and castings for particular designs happens well before production starts, manufacturers are usually faced with expensive and time-consuming problems: every time there is a change in design means that tooling will also need to be adjusted. Another advantage of AM is that it enables companies to be less dependent on tooling and casting since it allows for the creation of prototypes that do not require either of them.

Reduce in product Weight:

Fuel efficiency improvement is a constant effort amongst Aerospace and Automobile companies due to the rise in demand for compliance of industry standards and for the revenue growth it generates through delivering value to consumers. Weight reduction is certainly one of the ways to go to improve fuel efficiency. Since, fuel accounts for a third of the revenues, reducing the aircraft's weight is crucial. Aerospace companies use AM to produce lightweight versions of components used in aircraft.

Ease of Customization:

Many customers enjoy customizing their product to be unique. It can be external design features as well as internal components. Since, it's a special order; this has a cost for the manufacturers but with 3D printing, creating custom products are simple compared to conventional.

Simple Production Line:

Setting up the production line for AM is simple compared to conventional type. Only one AM machine performs all operations to complete all types of parts, when compared to traditional that requires more than one machine.

THANK YOU

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