

Latest Trends in Additive Manufacturing Technology

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Abstract - Aim of this article is to study the various trends followed by the industries and global manufacturing firms in the field of additive manufacturing. During past 6 months alone, various global multinational organizations and manufacturers applied and granted patents in the field of additive manufacturing researches. Also, COVID-19 pandemic gave the opportunity to the students, makers and research scholars globally, to work on medical solutions by the utilisation of additive manufacturing technology.

Key Words: Rapid Prototyping, Additive Manufacturing, 3D Printing, COVID-19, Fused Deposition Modelling

1.INTRODUCTION

1.1 INTRODUCTION TO ADDITIVE MANUFACTURING

Additive Manufacturing is the modern physical modelling process of a virtual design using a special class of machine tools technology. Additive Manufacturing involves adding and bonding materials layer by layer to build the objects, and so it is also called 'Layered Manufacturing' and / or 'Solid Freeform Fabrication'

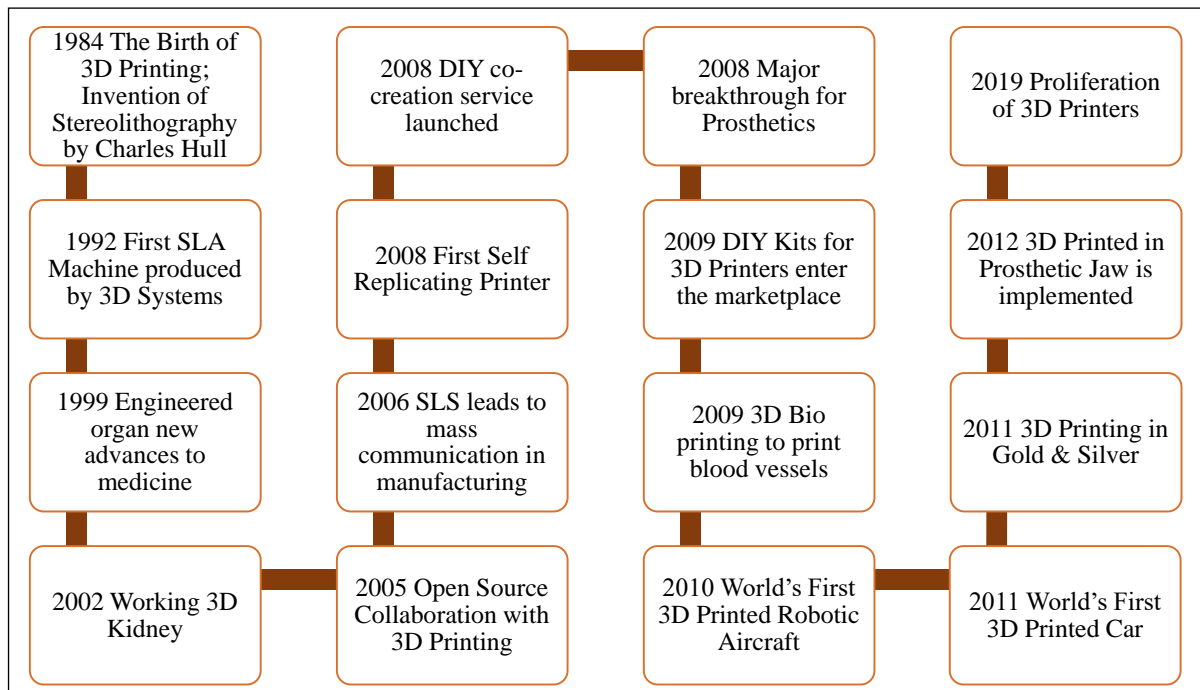


Fig -1: History of 3D Printing Timeline

1.2 CHALLENGES IN MANUFACTURING WORLD

The major benefits of Additive Manufacturing technology include the fact that we can build the models with various complex geometries or intricacy, as well as we can reduce the objects building that are more complex, relatively fast as well as manageable and straight forward workflow. In some Additive Manufacturing methods, we can even vary the body materials in a constrained manner or at specific location in a body.

1.3 TECHNIQUES OF ADDITIVE MANUFACTURING

There are various techniques available in Additive Manufacturing. We can choose any of them according to the application.

- Vat Photo polymerization
- Martial Extrusion
- Material Jetting
- Binder Jetting
- Powder Bed Fusion
- Direct Energy Deposition
- Sheet Lamination
- Powder Bed Fusion

2. MODERN APPLICATIONS OF ADDITIVE MANUFACTURING

The starting era of 3D printing in ‘Rapid Prototyping’ were established on the parameters of mechanical prototyping as a special method class for boosting the most necessary stages of product development with a fast and accurate process of building objects that takes into consideration. Various emphases of an item to show up more rapidly and productively at an ideal product development system. This sets aside time and cash at the start of the whole item advancement process and guarantees certainty in front of creation tooling.

Prototyping is still a big, sometimes overlooked, application of 3D printing today. Since the advantage of additive prototyping, the consequences and improvements of process and materials have been taking the product development process chain further downstream for applications. Tooling and casting applications have been developed using the advantages of different processes. Again, these applications are increasingly used in the industrial sector.

Similarly, for final production operations, efforts continue to improve. As for the industrial revolution and global markets are moving towards the industrial 3D printing techniques for lot of applications. Here we have listed:

- Dental & Medical
- Aerospace
- Automotive
- Architecture
- Fashion
- Food
- Jewellery
- Consumers
- Tooling

Parameters	Additive Manufacturing	Subtractive Manufacturing
Working Principle	Adding material layer wise to create a model	Removing material to obtain desired object.
Methods	SLS, DMLS, FDM	Manual/CNC/VMC Machining
Surface Finish	Stepped Surface	Stepped / Smoother Surface
Operation Time	Slow Process Take More Time	Fast Process Takes Less Time
Costing	Fair Cheaper Process	Expensive Process
Operators / Men Power	Fully Automated, No Men Power is needed	Automated but Skilled Operator is required

Table -1: Comparison Manufacturing Concepts

3. POTENTIAL & TRENDS OF ADDITIVE MANUFACTURING



Fig-1 : Concept of Additive Technique

3.1 GLOBAL EFFECTS OF ADDITIVE MANUFACTURING

Additive Manufacturing effects mostly how our products can be manufactured – the nature of the technology permits new ways to develop the technologies by taking social, environmental and economical parameters into consideration with universally desired results.

The main factors affecting the above statements is that the technology of 3D printing has a lot of potential to make the faster producing the products as well as end user and consumer products. Even we can reduce the restriction and constraints involved in supply chain of production.

The feature of customisation of additive manufacturing technology is a potential way to engage the consumers towards the trend as well as tends to decrease the need for inventories by producing small all batches of production on demand. Producing the end-user products using in-house additive technology is more feasible as compared to shipping spare parts from the part of the world. It could impact small and large businesses globally as well as consumers and also interacts on the global scale in the upcoming times. The ultimate target for many makers, designers, communities and consumers for having their own 3D printer in-house or in-campus is that it the design assets in digital formats for any customised product are easily available on the online CAD platforms as well as easily accessible and allowed to share to the machines which can be loaded with the appropriate materials and easily producing the prototypes in a short time.

The more adoption of additive technologies would be trending towards re-engineering or redesign on a lot of products as well as completely new innovations. The complex geometry and complicated shapes which were impossible to produce previously can be produced easily using additive manufacturing techniques. But we can say that this journey has just begun and it's believed that it has good potential to grow the market of innovation and will be very useful for local manufacturers and consumers.

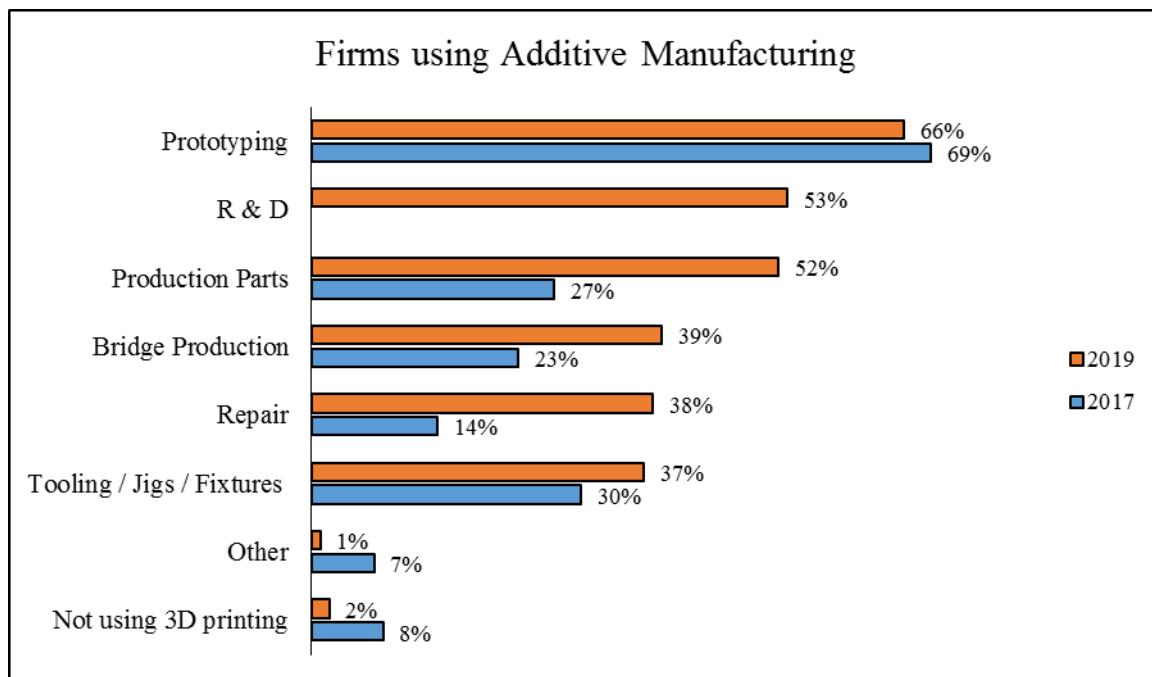


Chart -1: A Survey of AM Manufacturing Stakeholders

3.2 BENEFITS & VALUES OF ADDITIVE MANUFACTURING

The additive manufacturing technique is very beneficial for makers local manufacturers as well as industrial forms as compared to conventional production and prototyping methods even for their products which cannot be adopted by the traditional one.

3.2.1 Customisation

The additive manufacturing technology is more comfortable with mass customisation and also having the ability to personalize all the products as per the needs of individuals as well as personalised requirements. The nature of Technology allows manufacturers to produce a number of different products even within the same build and develop according to the end-user requirement with no extra processing charge.

3.2.2 Complexity

One of the most used tool advantages of additive technologies is producing objects with a higher level of complexity which simply cannot be produced physically using any other techniques. When this approach adopted by artists and designers using visual aspects, it made a significant effect on the industrial applications to reduce the manufacturing process as well as providing the customised product. The one notable example is the aerospace sector where these issues are prioritised.

3.2.3 Tool-less

The production of the tools is the costliest, time-taking and labour incentive process of any product development cycle in industrial production. The additive manufacturing technique has the potential to eliminate the essentials for production for low to medium volume applications. therefore, the lead times costing and Labour associated with the manufacturing can also be reduced. It is the most attractive parameter which involves a number of makers and manufacturers to leverage this technology. As mentioned earlier the complexity is a bonus advantage, showing the products and components can be specifically designed to avoid assembly requirements as well as eliminating the costs and Labour as much as possible with the production cycle.

3.2.3 Sustainable & Environmentally Friendly

Additive manufacturing is emerging as well as energy-efficient technology which provides efficiency in terms of manufacturing as well as environmental aspects. It also utilizes 90% of the standard materials therefore it produces a low amount of waste. Additive manufactured products life aimed to reduce the carbon emissions as compared with conventional products.

Rapid prototyping promises a local manufacturing model, in terms of eliminating large inventory and unsustainable logistics for shipping high amount of end-user products globally.

4. LATEST RESEARCH IN ADDITIVE TECHNOLOGIES

Over the past 6 months alone, almost 500 3D printing patents were either requested or granted for various geographic areas around the world. This statistic alone can offer a view into the vibrant scene of 3D printing patents, with several tech giants actively involved. Some are usual suspects like HP or 3D Systems. Others may seem unexpected, like Sony Computer Entertainment, Microsoft, IBM, LG and Amazon.

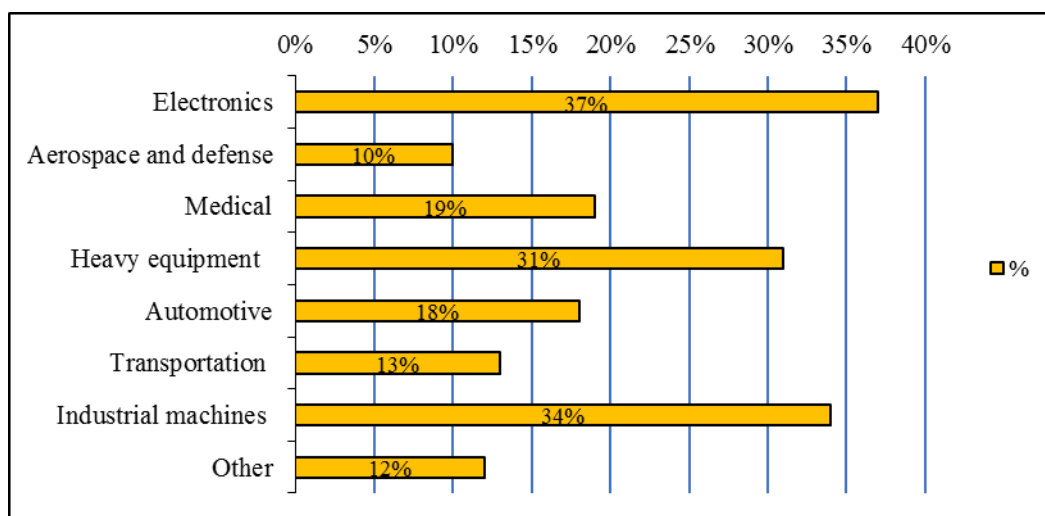


Chart 2: A Survey of Additive Manufacturing Applications

HP was the company that appeared the most in patent news, with 38 patents filed for or received, which makes sense given the sheer R&D power of the company and its new AM development centre. The second most present company is XYZ printing – which also makes sense since the Taiwanese company manufactures 3D printers leveraging several different technologies. Further down the list is Autodesk and Velo3D, two companies making some big moves in AM recently (mostly with innovative software to run the AM hardware). In between are literally dozens of Chinese companies and universities with some very, very interesting ideas for materials and processes.

NASA is one of the major clients of this additive manufacturing technology NASA implemented 3D printing Technology from the food to the first Zero Gravity 3D printer in this space. We would like to add that there is a 3D printer on the market named The Photonic Professional GT, that can produce the objects no wider than a human hair.

5. ADDITIVE MANUFACTURING TO FIGHT CORONAVIRUS

Due to covid-19 pandemic, all the students, teachers cannot go to their colleges, university campuses. Still they are not sitting idle. The students around the world are busy working on innovative projects like 3D printing face shield masks coding Apps which can help and protect people in need as well as to monitor the disease progression independent time.

5.1. Manufacturing Personal Protective Equipment (PPE)

The production of enough Personal Protective Equipment / PPE kits is one of the most important challenges for the local health organizations as well as the government in recent times. These PPE kits can be used for COVID Warriors who are directly in contact with the patients and they are at high risk for being infected by the virus. Dresden Technical University as well as a medical and biotechnology association - Bio Saxony, is trying to help to reduce the shortage of this equipment. There are some researchers working on this project and they are producing 3D printed as well as injection-moulded plastic visors for the current application. These visors can be delivered to the network of hospitals as well as doctors and fire departments globally. In such a situation, the '3D printing media network' proved very useful as an open-source platform which provides the researchers as well as Technology enthusiasts for producing such useful products. The research scholars from these organisations are also involved with various quality control as well as disinfecting the shields and also driving the distribution chain.



Fig-3: Face Shield produced by joint research project

Fig-4: Face Shield used at Dresden Fire Department

5.2. PRODUCING FACE SHIELDS FOR THE NHS

Elizabeth is one of the postgraduate research scholars from University of Warwick England. She is a specialist in additive manufacturing technology. She is working with her team on the similar project to produce fused deposition modelling and 3D printing products. They went through the large-scale production for the UK National Health Service. Elizabeth with her colleagues, able to print or additive manufacturing headband and wisper in less than three minutes. Designs have been created using Autodesk fusion 360 tool and can be used with any size of FDM 3D printer nozzles.



Fig-5: Face shield holders by Elizabeth Bishop

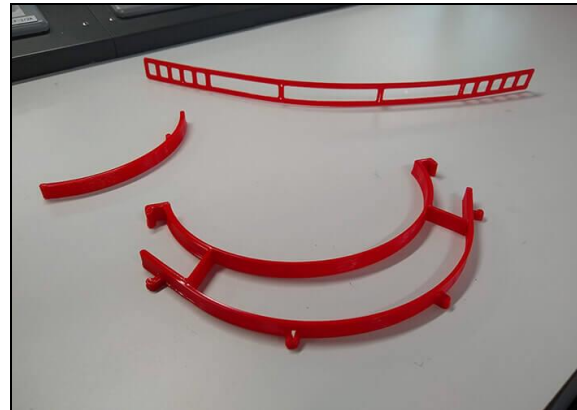


Fig-6: 3D Printed Headband for the face shields

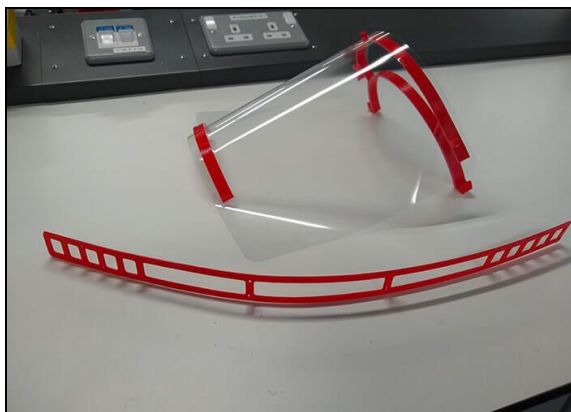


Fig-7: Face shields projects at University of Warwick



Fig-8: Elizabeth Bishop, PhD student and her team

5.3. PRODUCING MORE COMFORTABLE MASKS

One Italian start-up company used additive manufacturing techniques to redesign the Scuba mask for medical use in Italy. As we observed the traditional mask wearing for several hours' scan results into the complaint of a deficiency of oxygen as well as headache.

The University of Stanford also organised the hackathon for global students inviting the design ideas on how we can improve Scuba mask design for better ergonomics. They aimed to produce a new design which should be more comfortable reusable as well as it should comply with the standards of FFP2 respirator mask for N95 mask.



Fig-9: Edison Matias, submitted his design to Stanford University's competition

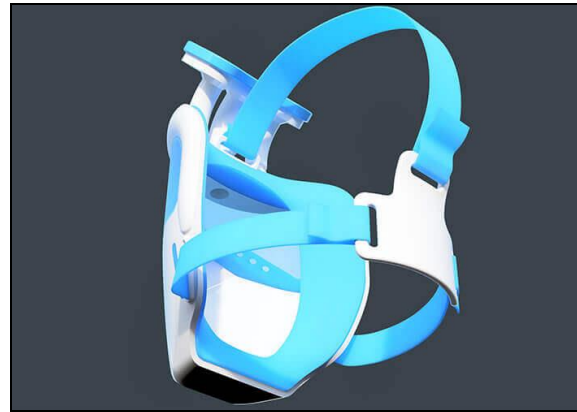


Fig-10: 3D Model of future mask by Edison Matias Junior

5.4. Local Mask Attachment Solutions

Various local problems were identified during COVID-19 lock down period. Also, some solutions have been adapted by the students from different engineering disciplines. The most common product among 3D printed solutions is step extenders which adjustable mask straps which can be used to hook The Mask and to get the ears relaxed. Mask attachment can be 3D printed in various customise designs and 3D models can be easily modelled using Autodesk fusion 360. Also, various CAD models are available as open source assets on the internet. So, these models can be manufactured and can be distributed globally without wasting time. This mask extender can be very helpful to covid-19 worriers, doctors, paramedical and various government departments.



Fig-11: F.D.M. Printed Mask Straps



Fig-12: 3D Printed model of straps used to hold face masks

6. CONCLUSIONS

The various platforms like 3D printing Network which provides an open-source platform to the engineer students teachers Academy Asian Research Scholars to work on various design thinking projects. These platforms are very useful with various CAD documents required for Research and production regarding COVID-19 pandemic. The corporate life Autodesk incorporation provided a lot of professional design tools free of cost to the students and educational institutions to develop and generate innovative projects. additive manufacturing a large potential to develop and evaluate many companies how they design and prototype. However, just small businesses engineers, consultants and individual makers have to struggle to access and search Technologies. the world of additive Technologies in inspiring directions and pushing the boundaries to discover the latest method and applications of additive manufacturing.

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BIOGRAPHIES



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