

## Implementation of Additive Manufacturing in Educational Institutions by Enrichment of Technology

#Nelakuditi Sudheer<sup>1</sup>,

PG (M.Tech-Machine Design) Student,  
Gudlavalleru Engineering College, Gudlavalleru, Andhra Pradesh, India

\*Chinnam Durga Jaya Teja<sup>2</sup>,

PG (M.Tech-Machine Design) Student,  
Gudlavalleru Engineering College, Gudlavalleru, Andhra Pradesh, India

~Ganta Raju<sup>3</sup>,

PG (M.Tech-Machine Design) Student,  
Gudlavalleru Engineering College, Gudlavalleru, Andhra Pradesh, India

**Abstract:** Additive manufacturing, popularly known to present as 3D printing, is one of the emerging technologies in the Modern manufacturing sector since last two decades across the world. As the name implies that, Additive manufacturing is opposite to Subtractive manufacturing or Conventional manufacturing in which the material is gradually removed or subtracted from starting material to produce desired shape of the object. In Additive manufacturing, the desired shape of the object formed by adding material in a layer-by-layer manner. The main object of this paper is to bring the awareness about Additive manufacturing or 3D printing (3DP) technology and to implement such an emerging and advanced applied science in educational institutions to strengthen the nation towards fulfilling the requirements of Digital manufacturing.

**Keywords:** Design For Manufacturing (DFM), Manufacturing For Design (MFD), Rapid Prototyping, 3DP, 4<sup>th</sup> Industrial Revolution (IR), IoT (Internet of Things).

### I. Introduction

Additive manufacturing is become one of the breakthrough technology in manufacturing over last three decades. In some of the industrially developed countries Additive manufacturing or 3D printing successfully overcomes its infant stage from *Rapid prototyping* to *Metallic 3DP* via printing of polymers, plastics, etc. The global manufacturers were changing their perspectives *Design for Manufacturing* to *Manufacturing for Design*. It is very important strategy to implement such type of wonderful technologies not only in Educational institutions but also in Research organizations and in manufacturing sector to raise up the nation (India) for sustainable economic growth and to reach the mottos of *Make in India & Skill India* (Pradhan Mantri Kaushal Vikas Yojana - PMKVY) programs initiated by ruling bodies of the nation. The primary object of these initiatives is to nurture the innovation, enhance skill development and strengthen the India's manufacturing sector.

### II. Why 3d Printing/Additive Manufacturing?

This new technology has invaded every industry from automotive, aerospace, defense, consumer products to medical and dental. The major applications of additive manufacturing include:

- ✓ Functional prototypes,
- ✓ Patterns for prototypes,
- ✓ Demonstration models,
- ✓ Visual aids,
- ✓ Making complicated Jeweler parts,
- ✓ Customized products such as toys,
- ✓ Defense products,
- ✓ Tooling components, and
- ✓ Patterns for metal casting.

Some of the reasons to implement the Additive Manufacturing are:

- ✓ Simplified product design,
- ✓ Reduction in Weight,
- ✓ Capable to produce Complex Geometries,
- ✓ Design Freedom,
- ✓ Short time for Production,
- ✓ Low-Quantity economy, and
- ✓ Reduced Assembly.

### III. Global Surveys Says:

"Once a niche market, 3D printing has continued its rapid transformation into a broad-based mainstream technology embraced by consumers and enterprises around the world," said Pete Basiliere, research vice president at Gartner Inc.<sup>[1]</sup>, United States of America.

According to PwC survey of US manufacturers<sup>[2]</sup>, 2/3 companies are already adopted 3DP in various forms i.e., from research and development stages to production of finished objects or parts.

3DP is now experiencing extensive adoption beyond its application in specialist industries. Recent advances in 3DP technology have led to additive manufacturing being occupied into the mainstream industrial manufacturing process.

In India, especially eastern India, the manufacturing companies are developing the Additive Manufacturing technology slowly. There is greater flexibility and manpower to India to bring the manufacturing reforms in Asia. Due to the lack of base level improvement and encouragement, the implementation and wide-spreading of this technology in India is still in emergent stage.

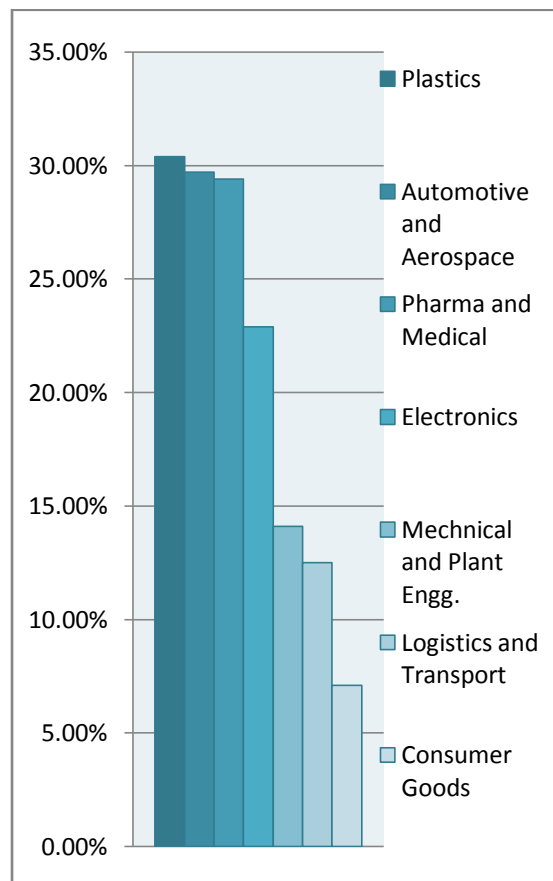


Figure 1: Percentage usage of 3DP in Various Industries  
Source: EY Global 3DP study, April, 2016.

The EY's global 3DP report, 2016<sup>[3]</sup> says, as shown in figure 1, Plastics manufacturing industries uses the 3DP technology above 30%. Next, Automotive and Aerospace industries; Pharma and Medical industries

grab the usage about 29%. Even though there is greater scope to use the 3DP technology in Mechanical and Transport sectors, the substantial growth was not taken place.

From the study of Royal Academy of Engineering-UK, the timeline of Additive Manufacturing technology as follows:

Year	Field of application
1988-1994	Rapid prototyping
1994	Rapid casting
1995	Rapid tooling
2001	AM for automotive
2004	Aerospace(polymers)
2005	Medical(polymer jigs and guides)
2009	Medical implants(metals)
2011	Aerospace(metals)
2013-2016	Nano-manufacturing
2013-2017	Architecture
2013-2018	Biomedical implants
2013-2022	In situ bio-manufacturing
2013-2032	Full body organs

Table-I: Timeline of AM<sup>[3]</sup>

The themes of Industrial Revolution are:

1<sup>st</sup> IR- Hand Production methods to Invention of Machines;

2<sup>nd</sup> IR(Technological Revolution)- Invention of Machine tool and Mass production;

3<sup>rd</sup> IR(Digital Revolution)- Personal Computer, Internet, Digitalization of Manufacturing, and

4<sup>th</sup> IR(Present era)<sup>[4]</sup>- Robotics, Additive Manufacturing/3DP, IoT, etc.

So, transition of any invention or innovation from past to present is a very common thing in manufacturing to meet the requirements of modern community.

To overcome this scenario, the government needs to take the initiation towards the implementation of this technology in educational system by enriching the present technology to sustain the nation in the global competitiveness of manufacturing.

#### IV. Importance to Enactment of this New Technology in Educational Institutions:

There is a greater importance to establish this new technology in Educational Institutions, especially in Engineering and Bio-Medical Departments to identify and develop effective educational practices towards Advanced Manufacturing Processes. Due to this idea there may be a possibility to learn the students through the Design and Fabrication Processes. With the use of Desktop 3D Printers students may have the opportunity to visualize their creative ideas and concepts in the form of reality. This capability offers reappraise the academic curriculum and renew essential interconnections among the historically related subjects such as *Manufacturing*

The Present Version of Education in Indian Engineering Educational Institutions was implemented so many years back, and out-dated. The compartmentalization of any Engineering Stream into different subjects and the structuring of academic curricula have provided an efficient means of educating large numbers of students. But unfortunately, today's Educational System provides out-dated knowledge to the Student-Community, not meant for entirely. Today, the Government and Professional Bodies in India such as AICTE; UGC; AMSI; ISNT; IE(I); ISTE; and CSIR etc., are may need to tackle this situation and to promote the Digital Manufacturing.

## V. Strategies to Implement AM/3DP

As the 3DP is emerging trend, the implementation needs the constant encouragement and support from the Governments and Public sector industries to work together educational institutions. In India, every year the out coming number of Engineering Under Graduates are increases. But the career opportunities for them in industries are declines due to the reason of automation. Off course, not only automation, every new technology may have the ability to create the new jobs.

Before the implementation of AM/3DP in Educational Institutions we need to focus on the awareness in the society and technical people is very important.

Some of the ways to create the awareness are:

- ✓ Maintain more frequent and relevant communication;
- ✓ Effective social media campaign,
- ✓ Conducting frequent Conferences and Workshops;
- ✓ Advertisements and Publicity;
- ✓ Implementation of "AM/3DP" as a compulsory subject to the relevant technical students;
- ✓ Making AM as Specialization in academic curricula; and
- ✓ Making Indian standards for Additive Manufacturing, etc.

## VI. Challenges Ahead

There are some technological and economical challenges<sup>[5]</sup> which restricts this technology . They are:

- ✓ High initial cost of 3D printers;
- ✓ Limited available materials(some of them are patented materials);
- ✓ Restricted size of the 3D printers,
- ✓ Lack of Manufacturing assistance;
- ✓ Lack of in-depth knowledge about this 3DP technology, etc.

## VII. Conclusion

Even though there are number of AM processes such as Stereo lithography ; Jetting systems; Selective Laser Sintering(SLS);Electron Beam Melting; High Speed Sintering; Fused Deposition Modeling(FDM); Sheet Stacking Technologies, etc. which are successfully implemented in industrially developed countries, we can't reach yet. So, we need to pay more attention on this new technology and there is importance to develop from gross root levels.

## VIII. References

- [1]. Gartner's market report on 3D printing, October 13, 2016. <http://www.gartner.com/newsroom/id/3476317>
- [2]. PwC market report on 3D printing, August 21, 2016. <http://usblogs.pwc.com/emerging-technology/the-road-ahead-for-3d-printing/>
- [3]. "Additive Manufacturing (3D Printing): Opportunities and Constraints", A summary of a round table forum held on 23 May 2013 hosted by Royal Academy of Engineering, UK.
- [4]. Schwab, Klaus (January 11, 2016). *The Fourth Industrial Revolution*. World Economic Forum. ISBN 1944835008.
- [5]. A survey report by The Tech Panda, January 7, 2014. <https://thetechpanda.com/2014/01/07/3d-printing-opportunities-challenges-future-india>