

An Empirical Study to Understand the Effectiveness and Scope of 3D Printing in India

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Abstract

3D printing features such as self-assembly, multifunctionality have enormous potential in the automotive industry. This paper is predicated on the idea that it highlights the various features and compatible materials of 3D printing technology that are important for automotive applications. There is also a section on the various critical components used in the automotive industry that can be developed using 3D printing. There is also a section on how self-healing features, stimulating mechanisms, and stimulus-responsive materials can revolutionise the automotive industry, particularly in terms of safety and maintenance. The associated challenges and future aspects are discussed near the end of the paper.

Keywords

3D printing, manufacturing, automobile, additive manufacturing, scope

Introduction

3D printing, also known as additive manufacturing, is a method of creating three-dimensional solid objects from a digital file. When compared to more traditional ways, 3D printers are more accurate, more cost-effective, and more capable of making complex objects. They are some of the most accessible and adaptive equipment. 3D printing makes it possible to create complex shapes with less material than traditional manufacturing methods. It is possible to produce personalized products in small quantities. It enables you to design and edit things quickly and with a great deal of flexibility. In the global printing landscape, 3D printers are emerging as key growing printing technology. According to 6Wresearch, the India 3D printer market is expected to exceed \$79 million by 2021, with automotive applications accounting for the lion's share of the revenue. Educational and medical applications are also expected to grow rapidly. Arts and crafts, interior decoration, fashion accessories, footwear designs, jewellery designs, animation & gaming, customised footwear designs, furniture, and modelling are some of the other niche applications. The market for 3D printers in India is still in its early stages, but it has enormous growth potential in the coming years. Technology has immense scope for improvements and increases the productivity of various sectors of any economy. 3D Printing is a type of technology which creates objects by creating layers on layers using a computer. 3D Printing is one of the technologies which has the highest projection for use in the coming future in India. Low market awareness, cost constraints, and lower domestic production have been identified as major barriers to adoption in the country. Domestic production, low manufacturing costs, and increasing penetration across multiple applications, combined with the Make-in-India campaign, are expected to drive the Indian 3D printer market. A substantial GDP increase has been attained within Indian local economic circumstances. Furthermore, AM systems can be used to replace traditional and common production methods. However, with low production costs, increased awareness and penetration, and advancements in material research, the 3D printer market is expected to grow rapidly in the coming years. 3D printers have been used primarily in

medical, architecture, automotive, industrial, aerospace & military, and other applications in India's 3D printer market, with automotive accounting for the largest revenue and volume share. Medical and aerospace & military applications are expected to grow rapidly in India's 3D printer market over the years, owing to increased spending on R&D of aerospace & military-related equipment.

Literature Review

Our community's most useful machines Most 3D printers employ FDM or fused deposition modelling. The quality aspects of FDM built parts, including hardness, tensile strength, compressive strength, dimensional accuracy, surface roughness, production time, yield strength, and ductility, are most important to manufacturers and end-users.

3D print technologies can be used in many different industrial environments and deliver major disruptions, in a variety of areas of the trade, for instance, space, jewellery, food, the medical sector, domestic security, furniture, clothing and power. This opens up a plethora of entrepreneurial opportunities in and around the 3D printing framework. Because of its unique properties, the 3D printing industry is well suited to consumer entrepreneurship. Several startups in India are primarily focused on 3D printing and industrial expansion. A substantial GDP increase has been attained within Indian local economic circumstances. It has surely opened doors in some specific industries - Aerospace & Defence, Automobile Sector, Dental & Medical,

Consumer Goods, Industrial Goods. 3D printing has been implemented among orthodontists in India. It has transformed diagnosis and treatment in dentistry and in orthodontics. This new innovation can improve the treatment procedure and result in better results and even the patients are more aware of their treatments and outcome. In the Invisalign system, 3D printing can help align the patient's teeth to make a series of 3D printed models for the manufacturers. Concrete 3D printing aims at enhancing the construction procedure on many levels. It reduces the time taken for the construction process and reduces the cost due to overproduction. It also leads to minimal use of labour; it also provides flexibility in building structural shapes which are not possible to build by traditional methods which leads to an improvement in the overall safety. Our healthcare sector is incorporating these technologies into a more intensive and core working model. 3D printing in the healthcare sector is primarily used to create draughts or cells that can be directly used in clinical practice. However, there is a huge potential for their use in medical education and research in India. The paper informs about the significance 3D printing is playing in the health care sector, few of them are medical uses for the 3D printing technology like Tissue and organ fabrication, the creation of customised prosthetics, implants, anatomical models, educational physiology and pathology models, simulation materials, improving student-centred skill-based materials, and pharmaceutical research related to drug dosage forms, delivery, and discovery. The Indian Aircraft Industry has emerged as one of the world's fastest-growing industrial endeavours, with automation in the majority of its production and manufacturing areas. Technological advancements have fuelled this expansion, and the industry's increasing competitiveness has compelled it to seek out new avenues and strategic alliances. If the current scenario is pragmatic and meets industrial needs. If the current scenario is pragmatic and in line with industrial needs, 3D printing will play a more important role in total aircraft manufacture and avionics in the coming years. According to current research, outsourcing of the parts and products for the entire aircraft manufacture will be a reality, thriving on improved production volumes of similar parts for various end-users, with the advantage of "low or zero" waste, less impact on the

environment, apart from the possibility of local manufacture and just-in-time delivery, with the greater specification of the final product. According to research, outsourcing companies are looking to invest in new methods, and "timely production" will become a guarantee with 3D printing.

3D printing has made a slow yet significant impression. 3D printing has a prominent extent for innovation and imaginative solutions as it supports an application and design-driven approach. According to the survey, 3D printing technology use is around 26.67 per cent, which indicates a significant scope for penetration and acceptance growth. It would be advantageous if manufacturers and suppliers could launch awareness campaigns and, more significantly, provide orientation and training to potential and present consumers.

The 3D printing industry has the potential to transform the market in India, producing numerous jobs for part suppliers and other ancillary businesses, in addition to the assembly companies. However, we are still behind in many sectors including food and culinary, printed electronics, education and energy, arts and crafts, interior decoration, furniture to name a few. These are the areas that can be produced with focused efforts from the industry. The potential of 3D printing is boundless and limitless in imagination. With government support and through industrialists conserving to rebuke the misinterpretation of additive manufacturing, we can look at a modernised manufacturing industry in India.

Objectives

3D printing is a type of manufacturing technology which is considered to be faster than the traditional manufacturing technologies. 3D printing provides multiple opportunities across all sciences for visual aid and learning practices. The entire aim of 3D printing is so that models are scientifically tested in various fields such as engineering, healthcare, construction etc. 3D printing is capable of generating high revenue which is very beneficial for the various fields. This paper talks about the use and benefits of 3D printing in the automotive sector in India and how effective research was conducted to understand 3D printing technology in automotive sector.

Hypothesis

H₀: 3D printing is not the future of India

H_a: 3D printing is the future of India

Research Methodology

Research was conducted to understand the effectiveness of 3D printing technology in the automotive industry. The study conducted was aimed at car parts manufacturers from Ford Motors, Toyota, Kia, Volkswagen, Bugatti, Mercedes, and Honda. These seven companies were selected because they have been using 3D printing technology in their automotive manufacturing. Also, seven respondents were provided with sample templates for a series of 5 systematic questions focused on finding the success of 3D printers in the company's production processes and five random open-ended questions which were aimed at investigating the impact of

using 3D technology in optimising the production. The results obtained in the research show that the participants had a positive impact of 3D printing technology in improving automotive production process. The total average data for each item have a high percentage, which means all seven companies have already benefited from usage of 3D printers in its production process. Using 3D printing in the production reduces the cost per unit of each car produced (as it decreases the motor vehicle assembling cost for the company) which reduces the price per unit of all produced vehicles. The company's overall manufacturing cost goes down and increases the net revenue and assures profitability for the company.

Data Interpretation

A study was carried out to see how effective 3D printing technology is in the automotive sector. Ford Motors, Toyota, Kia, Volkswagen, Bugatti, Mercedes-Benz, and Honda were among the companies targeted in the investigation. Seven respondents were given sample templates for a series of five systematic questions aimed at determining the success of 3D printers in the company's production processes, as well as five random open-ended questions aimed at determining the impact of using 3D technology in production optimization. The total average data for each item has a high percentage, indicating that all seven companies have benefited from the use of 3D printers in their manufacturing processes. Using 3D printing in the manufacturing process lowers the cost per unit of each automobile produced (by lowering the company's motor vehicle assembly costs), lowering the price per unit of all produced vehicles. The company's overall manufacturing costs decrease, resulting in more net sales and increased profitability. The following data is mentioned in the table below.

Element of the 3D printers researched	Fo rd	To yot a	Ki a	Vol ks wa gen	Bu gat ti	Me rce des	Ho nd a	Fo rd
Improve the manufacturing cost per unit	96 %	98 %	98 %	97 %	96 %	99 %	99 %	96 %
Allow the creation of geometric complex parts	99 %	99 %	99 %	99 %	99 %	99 %	99 %	99 %
Saves on cost of manufacturing	95 %	96 %	99 %	97 %	96 %	98 %	99 %	95 %
Facilitates customization of automobile parts	99 %	98 %	94 %	97 %	99 %	98 %	96 %	99 %
Promoted the profitability and revenue generation of the automobile manufacturing companies.	99 %	99 %	99 %	99 %	99 %	99 %	99 %	99 %
Total/Average	97. 6%	98 %	97. 8%	97. 8%	97. 8%	98. 6%	97. 5%	97. 6%

According to recent reports and developments, AM development is gaining traction and may reach a tipping point within the next decade. In a recent Economist cover story titled "Print me a Stradivarius," hints of the future captured policymakers' imaginations. According to a Gartner report 6 from 2010, 3D printing is a transformational technology in the Hype Cycle's Technology Trigger phase7 (i.e., only 5-10 years from mass adoption).

Much has been written about the ongoing convergence of technical disciplines, particularly the so-called NBIC (nanotechnology, biotechnology, information technology, and cognitive sciences). "Revolutionary advances at the interfaces of previously separate fields of science and technology are poised to produce key NBIC transforming tools (nano-, bio-, information-, and cognitive-based technologies), such as scientific instruments, analytical methodologies, and radically new material systems." additive Manufacturing has the potential to transform the manufacturing process in a variety of critical ways, some of which are likely to occur sooner than others and will all likely apply to different end products at different rates. However, because additive manufacturing brings production closer to the consumer, production at any given point will likely be required in smaller numbers. Furthermore, AM will develop ondemand printing without the need for product inventories according to the report by Thomas Campbell, Christopher William, Olga Ivanova and Banning Garrett. These factors will ease the manufacturing process of the automobile industry.

Conclusion

The future of 3D Printing in India is considered to be bright and it has multiple opportunities and a high scope for many Indian companies. According to a research, Indian market for 3D printing is expected to grow by 20% from 2014-2019. 3D printing can help industries think and innovate faster, technology and manufacturing together can ensure better and enhanced quality. This advanced technology has helped industries lower the cost of production and prototyping helps them to speed up their new product development. 3D printing is extremely beneficial as it improves accuracy, speeds up the decision-making process and leads to an overall cost effective and improved product. In the automobile industry, 3D printing is considered a game changer and has proved very beneficial.

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