International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 7, November-December 2022 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

3D Printing in Business: An Overview

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ABSTRACT

3D printing is a manufacturing technique that transforms spools of plastic filament into physical objects. It is useful for prototypes and offers significant benefits for small and medium-sized production runs. It is quickly becoming a mature manufacturing technology. It continues to grow and increase its market value. Today, more and more companies in different industries are embracing 3D printing technology worldwide. 3D printing has been adopted by students, entrepreneurs, hobbyists, and various industries. This paper provides an overview of 3D printing in business.

KEYWORDS: *3D printing, 3DP, additive manufacturing, modeling, business*

How to cite this paper: Matthew N. O. Sadiku | Uwakwe C. Chukwu | Abayomi Ajayi-Majebi | Sarhan M. Musa "3D Printing in Business: An Overview" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-7, December 2022, pp.669-675, URL: www.ijtsrd.com/papers/ijtsrd52413.pdf

IJTSRD52413

INTRODUCTION

Emerging technologies are shaping our societies. Advancement in technology has helped us grow economically, environmentally, and socially. The manufacturing of goods has always been linked to societal developments. In the past, different methods for fabrication have served artisans' wishes to solve day-to-day needs. Today, automation and mass-production have liberated a great part of the society. The second industrial revolution brought the division of labor and the reduction of marginal costs into the manufacturing of goods. The third industrial revolution came with the information age and automation. Finally, we are now in the change towards the fourth industrial revolution, in which machines and humans will be connected in cyber-physical system. The four industrial revolutions are depicted in Figure 1 [1].

3D printing (or additive manufacturing) is the process of joining materials to make objects from three-dimensional model data, usually layer upon layer. This contrasts with traditional subtractive manufacturing technologies in which parts of a large block of material are selectively removed. To some extent, 3D printing technologies combined with a new means of Internet-based communication systems are enablers of digitalization, including the digitalization of manufacturing operations and the supply chain. With its inherent ability to drive mass personalization, the technology has the potential to usher in the fourth industrial. Three-dimensional printing is becoming the chosen method of manufacturing for lots of companies. This new and versatile method of producing goods is becoming the best choice for companies in the 21st-century marketplace. For those organizations used to traditional production processes, 3D printers can save a tremendous amount of time. Industries like automotive, aerospace, defense, consumer goods, healthcare, apparel and fashion, and construction will stand to benefit from 3D printing with reduced costs and improved lead time.

WHAT IS 3D PRINTING?

3D printing (also known as additive manufacturing (AM) or rapid prototyping (RP)) was invented in the

early 1980s by Charles Hull, who is regarded as the father of 3D printing. Since then it has been used in manufacturing, automotive, electronics, aviation, aerospace, aeronautics, engineering, architecture, pharmaceutics, consumer products, education, entertainment, medicine, space missions, military, chemical industry, maritime industry, and jewelry industry. 3D printing technology was first commercialized in the 1990s [2].

A 3D printer works by forming materials according to computer designs that are fed into it. Instead of using ink, it uses more substantive materials–plastics, metal, rubber, and the like. It scans an object and slices it into layers it can then convert into a physical object. Layer by layer, the 3D printer can replicate images created in CAD programs. In other words, 3D printing instructs a computer to apply layer upon layer of a specific material (such as plastic or metal) until the final product is built. This is distinct from conventional manufacturing methods, which often rely on removal (by cutting, drilling, chopping, grinding, forging, etc.) instead of addition. A generalized additive manufacturing process is shown in Figure 2 [3]. Models can be multi-colored to highlight important features, such as tumors, cavities, and vascular tracks. 3DP technology can build a 3D object in almost any shape imaginable as defined in a computer-aided design (CAD) file. It is an additive technology as distinct from traditional manufacturing techniques, which are subtractive processes in which material is removed by cutting or drilling [4]. A typical 3D printer is shown in Figure 3 [5]. The business uses of 3D printing are growing year by year.

3D PRINTING BUSINESS

3D printing for small businesses is becoming mainstream. A 3D printing business capitalizes on this emerging technology's ability to efficiently and affordably create three dimensional objects from graphic models. You can make money with your printer either by making it available to the designs of others or by designing printing, marketing, and selling your own product online. The benefits of 3D printing for small businesses are significant. These include the following [6]:

- Use less resources.
- Customize products.
- Save time and cut start up costs.
- Simplify production processes.
- Streamline repairs.
- Create production tools.
- Limit outsourcing needs.

A 3D printing business can produce several products for various businesses. It is a business where there is still plenty of space to compete in. A 3D printer can make anything, opening up a lot of options. Product development involves taking a design from idea to a physical, 3-dimensional prototype of the product. One of the benefits of this type of 3D printing business is that the inventory is small and lightweight. This is crucial if you are starting your business out of your home. . Once a niche technology, you can begin from doing business with the help of 3D machine at home**.**

If you're looking for 3D printing business ideas, there is no shortage of possibilities. Just looking at Amazon will give you ideas of many products for sale on the market. Get creative and start producing something they are never seen. You can use 3D printing business idea to expand your artist expression since 3D printer is the intersection between technology and art. We should not overlook the manufacturing industry in our list of 3D printing business ideas [7]. There are tons of available online resources if you are willing to learn.

APPLICATIONS

3D printing has a variety of uses in numerous disciplines such as healthcare, aerospace, engineering, manufacturing, entertainment, education, chemistry, mathematics, biology, history, and architecture. 3D printing technology is used in several industry such as jewelry business, printing industry, fashion industry, the medical industry, the machine industry, and education industry. We consider the following applications of 3D printing in business.

- *Manufacturing:* Manufacturing plays an essential role in the lives of many entrepreneurs and small business owners. 3D printing is becoming popular with manufacturers. It presents several advantages over the more traditional manufacturing methods of subtractive manufacturing and injection molding. Jaguar, the famous car manufacturer, is using 3D printing to create spare parts for its old vehicles. Items can be produced in plastic, glass or ceramic, so the possibilities are truly unlimited. Figure 4 shows the use of 3D printing in manufacturing [8].
- *Printing Industry:* 3D printing can help your business with prototyping or low-volume manufacturing. It also has applications in design, biomedical devices, and mechanical parts.
- *Healthcare:* Additive manufacturing is a technology perfectly tailored for the healthcare industry. It offers a range of precision healthcare solutions, including tissue and organ fabrication, creation of customized prosthetics, implants, and anatomical models, drug delivery, and testing, as

well as in clinical practice. Although 3D printing is already used in healthcare, it is still largely seen as a novelty. 3D printing is being used in the medical sector to help save lives by printing organs for the human body such as livers, kidneys, and hearts. The applications of 3DP in healthcare are already in the mainstream. These include medical device manufacturing, tissue engineering, pharmacology, surgery, anatomy, dentistry, orthopedics, prosthodontics, periodontics, personalized care, research and development, education and training, and medical imaging. Figure 5 depicts the 3D printing of human body [9,10].

- *Dentistry:* 3D printer can be used by dentists. A dentist can print out and produce models of dental replacements. The dentist takes a cast from the patient's jaws, then this cast is sent to the production center, where they are made and sent to the patient or their orthodontist. This product serves as a modern replacement for braces, as shown in Figure 6 [11],

BENEFITS

3D printing is the cutting-edge that has been around for about 40 years. It can provide some revolutionary benefits. Due to the speed and lower costs of 3D printing, product life cycles are reduced. For small production runs, prototyping, and small business, 3D printing is vastly superior to other manufacturing methods. Though 3D printers can be slow, they are adept at fulfilling low-volume production needs.

Other benefits of 3D in business include the following [12]:

- *Rapid Prototyping:* A major advantage of 3D printing technology is rapid prototyping, which is the ability to design, manufacture, and test a customized part in as little time as possible.
- *Fast Production:* Depending on the design and complexity of the part, 3D printing can manufacture parts in few hours.
- *Cost:* For small companies, 3D printing is the most cost-effective manufacturing process.
- *Minimizing Waste:* The production of a part using 3D printer requires only the materials needed for the part itself, with little or no wastage as compared to alternative methods. The production is therefore inherently environmentally friendly.
- *Flexible Design:* Any given 3D printer can create almost anything that fits within its build volume. It can create geometries impossible for traditional methods to produce.
- *Tangible Design:* Seeing a product on a screen cannot compare with actually touching and feeling a prototype.
- *Risk Reduction:* 3D printing allows a business to mitigate its risks in manufacturing.
- *Accessibility:* 3D printing systems are much more accessible and can be used by a much wider range of people than traditional manufacturing setups.
- *Print on Demand:* 3D printing business does require a lot of space to stock inventory, unlike traditional manufacturing processes.
- *Lightweight Parts:* 3D printing uses plastic as the main material. Plastic offers are lighter in weight than their metal equivalents. Figure 7 shows an example of a lightweight part produced by 3D printer [13].
- *Customization:* In today's world, consumers are demanding more customized and personalized experiences. It entails creating products that are precisely adjusted to the whims of customer.
- *Sparks Creativity:* New media tend to inspire new ideas. When you have a 3D printer, your mind will come alive and ablaze with new notions about how to promote your business and build prototypes for new products.

CHALLENGES

Additive manufacturing has its unique challenges. 3D printing equipment can be expensive to buy. One can avoid this cost by outsourcing your project to a 3D printing service company. Other challenges include the following:

- *Cost:* Some significant startup costs are involved in starting 3D printing service or business. The cost may be as low as $200 for hobbyists and as high as $10,000 for high-quality printers.
- *Limited Materials:* 3D printing commonly uses plastics and metals and available selection of raw materials is not exhaustive.
- *Limited Product Size:* 3D printers currently have small print chambers which restrict the size of parts that can be printed. The appeal of limiting assembly work is pushing 3D printing equipment to grow ever larger.
- *Customer Dissatisfaction:* To meet mounting customer expectations, you need to increase your on-time deliveries. Long response times to customer inquiries and failing to connect with your customers can lead to reduced customer confidence and loss of repeat business.

- *Reduction in Jobs:* A major disadvantage of 3D technology is the potential reduction in human labor in manufacturing, since most of the production is automated and done by printers.
- *Quality Control:* As 3D printing is becoming more popular and accessible, there is a greater possibility for people to create fake and counterfeit products.
- *Damage Risk*: Since the 3D printing technology is relatively new, no one is sure how liable it could be. If a 3D printed part causes harm or illness, it could result in a lawsuit.
- *Copyright:* As 3D printers proliferate, so do the means of easily producing protected intellectual property.

The final decision to use 3D printing boils down to whether it truly makes sense for your business and if the cost is worth the benefit.

CONCLUSION

3D printing is a technology that allows users to turn any digital file into a three dimensional physical object. 3D printers are becoming one of the most exciting technologies in the world because these amazing machines can create almost anything. Additive manufacturing continuously evolves and shows its worth. It is creating durable and safe products for sale to real customers in moderate to large quantities. 3D printing service involves taking custom orders from customers and printing the requested items for them. Such service can be used in almost all sectors. More companies will follow the existing ones as the range of printable materials continues to expand.

The future of 3D printing business will be brilliant. Ultimately, 3D printing is the printer of the future. It may have the potential to be a game-changer for small businesses. For more information about 3D printing in business, one should consult the books in [14-20].

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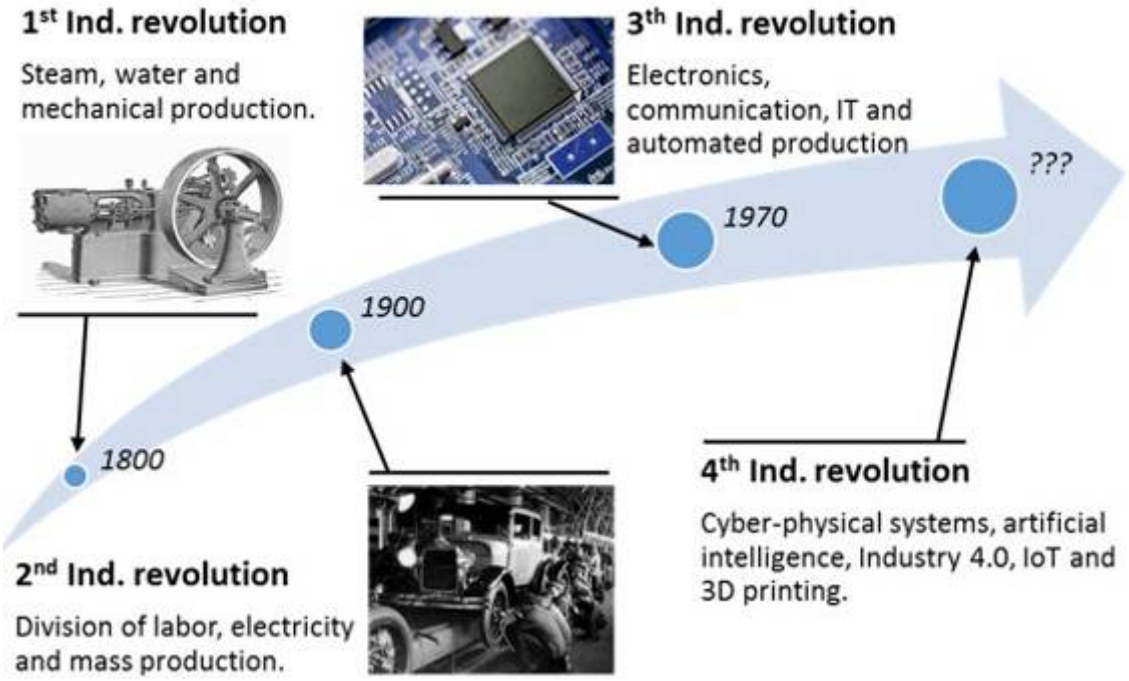

Figure 1 The four industrial revolutions [1].

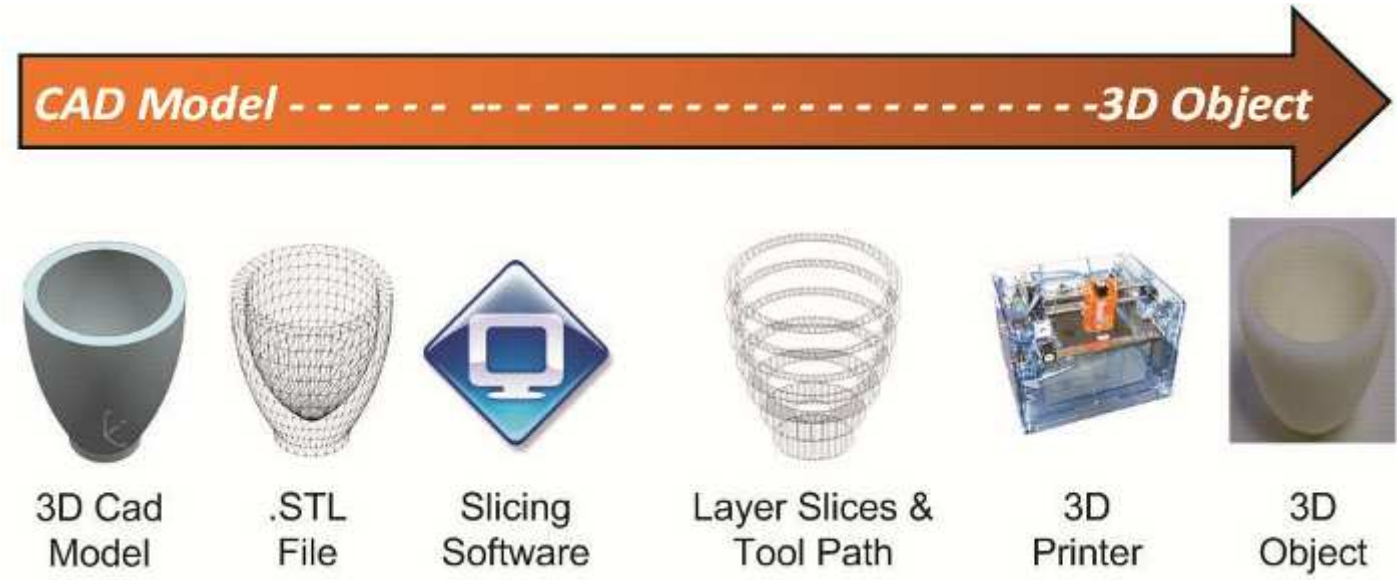

Figure 2 A generalized additive manufacturing process [3].

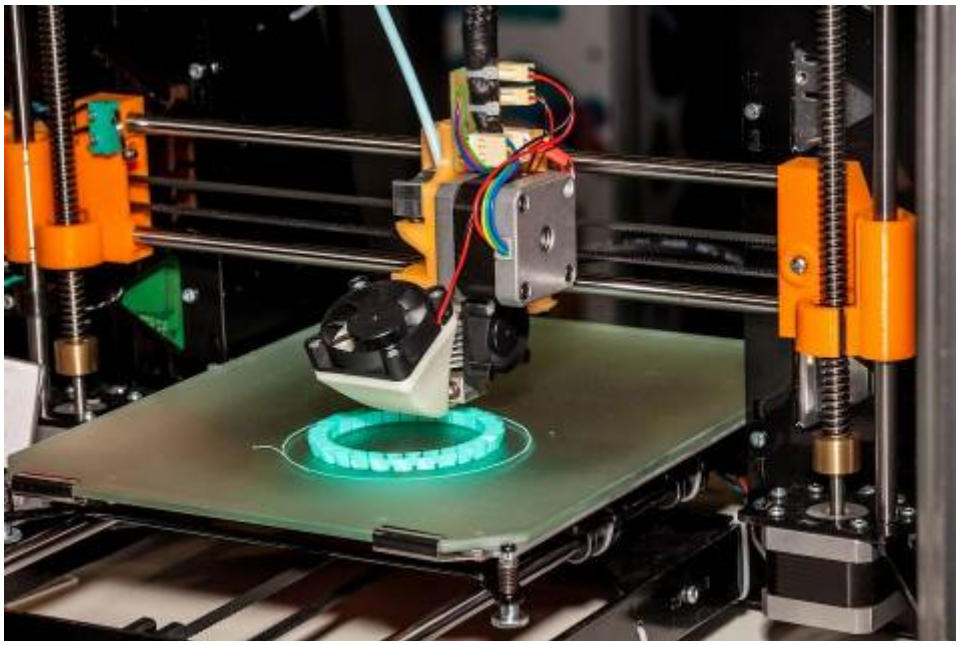

Figure 3 A typical 3D printer [5].

Figure 4 Use of 3D printing in manufacturing [8].

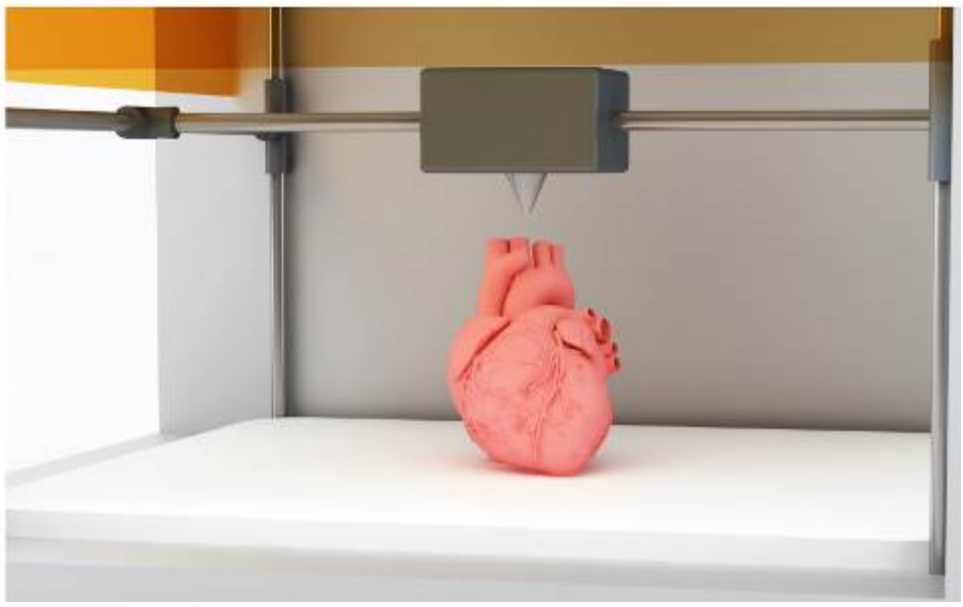

Figure 5 3D printing of human body [7].

Figure 6 Using 3DP to make a product that replaces for braces [9].

Figure 7 An example of a lightweight part produced by 3D printer [13].