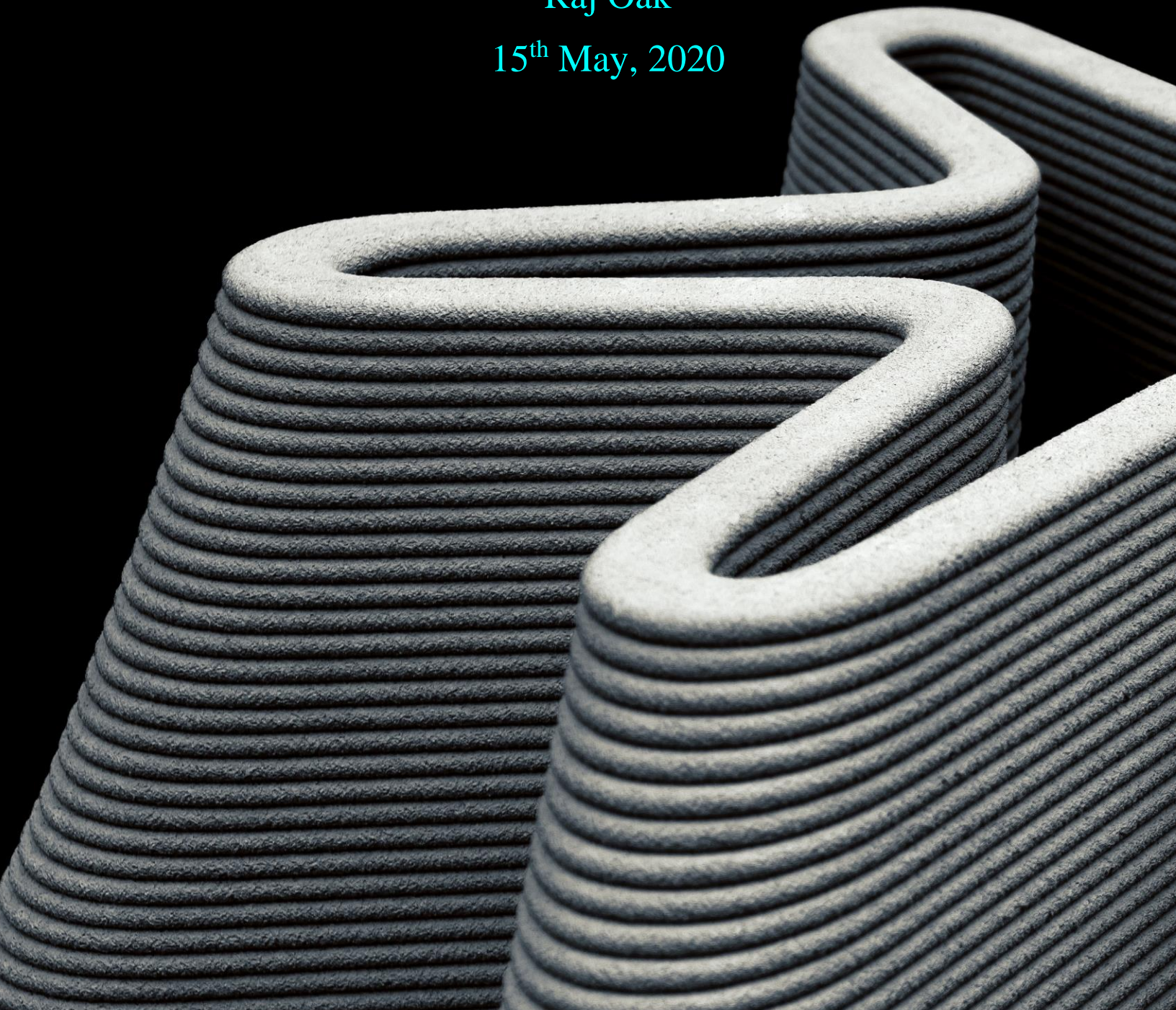


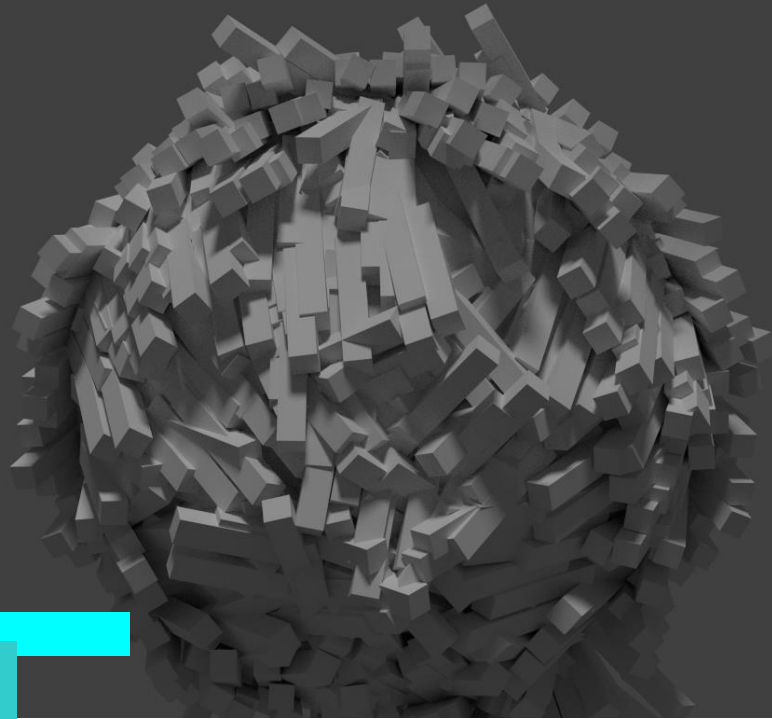
3D Printing Industry

Market Overview Report

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Purpose

The 3D Printing Industry Market Overview report is made as a personal project to gain expertise in market research, analysis and professional documentation.

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The report is made to assist *Universal 3D Printers*: a hypothetical company manufacturing 3D printer that is looking for upcoming market opportunities to introduce the new product line and emerge as a global brand in the 3D printing industry.



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Executive Summary

The purpose of this report is to provide a market overview of the 3D printing industry and what future landscape looks like. The report analyses and recommends possible actions in the purview of *Universal 3D Printers*, a hypothetical company that is currently manufacturing and selling a household printer and a professional printer and wishes to increase its product line based on industry insights.

The 3D printer is an additive manufacturing technique that is capable of printing several minute layers of material on top of each other to form the final shape of the product which can be used for functional prototyping or as an end component in an industry. The global 3D printer market is valued at USD 9.9 billion (2018), and it is expected to grow at a compounded annual growth rate of 23.2% for 2018-2024. This is a substantial growth rate as the general growth rate is around 5-10% for most of industries. North America's 3D printer market is projected to reach around USD 5.01 billion by 2022 opening up several opportunities for new entrants. North America is projected to have the highest growth rate followed by Europe and the Asia Pacific. The market is classified based on the technology used in the formation of the layers of material and the most widely used technologies are direct metal laser sintering (DMLS), fused deposition molding (FDM), and selective laser sintering (SLS).

Some of the industry trends suggest that the use of the printers would be dominated for prototyping followed by functional part manufacturing. The main market drivers are the increasing usage of the printers by the industry for prototyping needs and part manufacturing at a cheaper and time-effective manner. This technology is mainly used in by automobile, medical, aerospace, and consumer goods industry. The concept of fab shops for on-demand manufacturing is also gaining popularity.

Direct competition can be experienced from the market players offering similar products, some such companies are FlashForge Finder, Monoprice Voxel 3D, Tech X-Smart printer among others. Indirect competition can be experienced from the traditional methods of old school design houses like paper and wood models. The identified market barriers include the time required for functional part manufacturing and less need for domestic usage. The opportunity lies in developing industrial printers with DMLS technology. Some of the potential customers include toy shops, design studios, and the fashion industry. The Association of Manufacturing Technology is one of the most reputable industry association and it would be in the interest of the company to become a member and avail the facilities. The report concludes with final thoughts from the author.



Introduction

3D printers are devices that can generate or print three-dimensional physical objects having particular geometry making use of digital files, movable printing head, and a filament of appropriate material. 3D printing forms a segment of additive manufacturing in which the final component is made using a bottom-up fabrication technique.

There exists a wide range of these printers which either uses the material in the form of a filament, liquid, or a powdered solid which is used a base material, a printing head usually consists of an electrical heating mechanism to melt the immediate section of the filament, this printing head is connected to two or three-axis servo mechanism to allow the head to move with respect to a stationary or moving heated flatbed upon which the printing action will take place. As the filament is melted additional filament is continuously fed to the heater with a feeder mechanism at a preset rate. The printing head mover along the printing bed thus printing several layers of such materials on top of each other thus completing the final shape. In the case of the solid powder material, the bed is filled with powder and a high power laser used to melt the powdered material in subsequent layers giving rise to the entire product. Some of the liquid bed printers make use of resin material and use a UV light as a curating agent to solidify the resin thus generating highly accurate final products.

Cost of a 3D printers vary to a great extent, the hobbyistic printers are available from \$200-\$1500 (USD), while the professional printers range between \$3500-\$6000 (USD) and the industrial printers cost around \$20,000-\$100,000 (USD) [1].

This report tries to analyze several technologies associated with 3D printers and recommend robust strategies to help Universal 3D Printers achieve its goal.



This is Universal 3D Printers

Universal 3D Printers manufacture and sell complete 3D printing solutions for beginners as well as professionals and provides a robust aftersales service and 24X7 customer support.

Product:

Currently, the company is involved in manufacturing and selling two unique 3D printers that use fused deposition molding (FDM) technology, and have integrated filament storage and protective casing for the entire unit. The products are:

- ❖ U1B-3D: This product is a one-piece beginner's 3D printer and offers good printing quality, the price of the printer is USD \$300. Print Volume of 250 X 250 X 250 mm.
- ❖ U2A-3D: This product is a one-piece printer designed to help a professional build scale models and engineering components which have superior printing quality, the price of the printer is USD \$2500. Print volume: 500 X 500 X 500 mm.

Problem:

- ❖ Most of the entry-level 3D printers need to be assembled and do not offer adequate stability and have a poor working life
- ❖ Entry-level 3D printers are not always child safe as the hotbed (could reach 110 degrees Celcius) and the printing head is sufficiently hot to cause skin damaged if it comes in contact with skin.
- ❖ The professional printers do not always look aesthetically pleasing and contain the filament holder outside the entire printer assembly thus taking more space, less filament support, and suffer from higher noise levels making it unsuitable for modern compact construction lines.
- ❖ Lastly, the open type of 3D printers often emits particles thus making it unsuitable for indoor operation (Zhang et al., 2019) [2].



Company's Solution:

- ❖ *Universal 3D Printers* offer U1B-3D and U2A-3D printers which are completely pre-assembled units that are ready for plug and print application.
- ❖ Both the product comes with a transparent acrylic see-through enclosure which ensures that the product is child safe as it restricts any interaction with the heated components of the product.
- ❖ The printer looks aesthetically breathtaking as compared to the industry offerings and the transparent canopy allows to minimize of the particles emitted during the printing process thus making it safer.



Market Size

This section describes the dollar value of the market size of the 3D printing industry obtained from various sources with an explanation for the numerical quantifications.

Global 3D printing industry market			
Market Size in Dollars	Growth Rate	Base Year	Explanation
USD 9.9 billion (2018)	23.2%	2018	According to <i>Markets and Markets</i> , the global 3D printing industry market size is estimated to reach USD 34.8 billion dollars in 2024 with a CAGR of 23.2% for the forecast period. The main reason is the application of 3D printing technology allows hassle-free development of highly customized products, reduction in manufacturing cost, time-saving, rapid technology development, and government support [3].

North America 3D Printing Market			
USD 5.01 billion (2022)	20.1%	2016	According to Allied Market Research, the North American market is expected to grow to about \$5.01 billion by 2022 for the forecast period of 2016-2022. The major driving factors in this market are attributed to the effective use of materials, minimizing human error, product customization, and reduction in time and cost [4].
Asia Pacific 3D Printing Market			
USD 3 billion	25%	2013	According to Strataysys report, North America and Europe are leading the industry but the Asia Pacific is projected to be the leader in the industry in the future. The market is expected to grow at a CAGR of 25% from 2013 to 2022 and reach about \$15 billion presenting an attractive industry. The demand for different materials used in printing is expected to drive the market [5].

The global 3D printer market can be classified based on the technology used for making the final product. Different types of available technology fall under the following categories: stereolithography (SLA), selective laser sintering (SLS), fused deposition molding (FDM), multijet printing (MJP), direct metal laser sintering (DMLS), electron beam melting (EBM), inkjet printing, digital light processing (DLP). Among all these technologies the most widely used technologies are DMLS, FDM, and SLS [3].

The following diagram shows the distribution of technologies according to the market size.

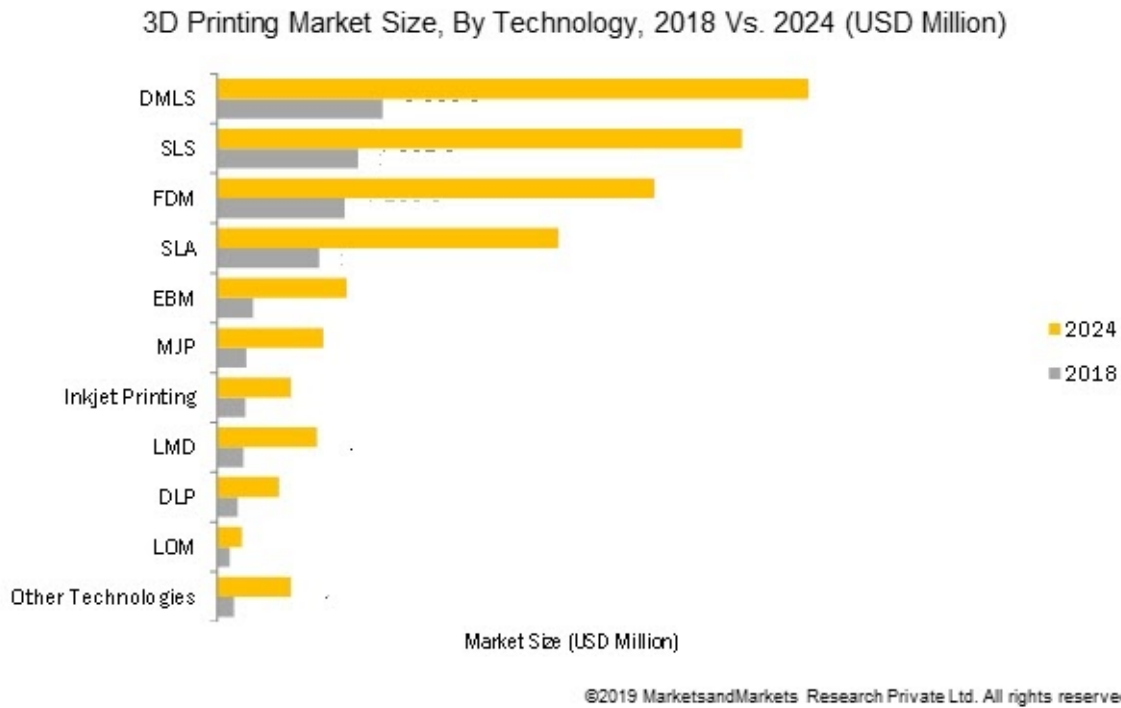


Image credit: Markets and Markets, 3D Printing Market by Offering

The current market conditions are more favorable for DMLS technology as it held the highest share in 2018-2017. This technology is used in applications including tooling and manufacturing of fixtures and jigs. This technology is used for metal 3D printing and hence finds its application in the complex metallic parts.

The 3D printing technology is majorly used in the industry for prototyping, functional part manufacturing, and tooling jobs. This helps different companies to reduce wastage while prototyping and saves the overall design time. The following diagram shows the application by different applications [3].

3D Printing Market Size, By Application, 2018 & 2024 (%)

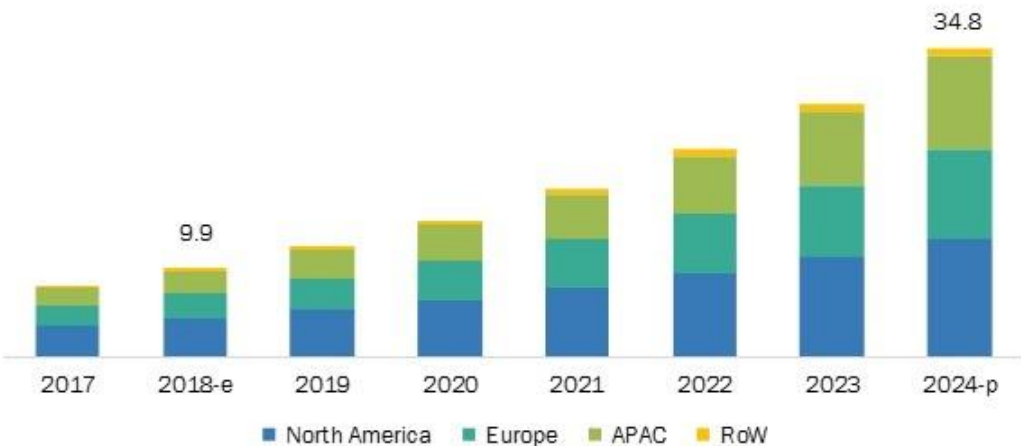


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Image credit: Markets and Markets, 3D Printing Market by Offering

The following diagram shows the distribution of market segments according to geographical distribution [3].

3D Printing Market, By Region, 2018-2024 (USD Billion)



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Image Credit: Markets and Markets, 3D Printing Market by Offering

Globally about 1.42 million units of such printers were shipped in 2018 and it is expected that this number will increase to around 8.04 million by 2027. Aggressive R&D efforts in several industrial domains would be the main cause of this upsurge [6].



Market Drivers

The following section describes the main trends in the market that are responsible for future growth trends.

- ❖ The industry is experiencing a shift in the application from prototyping to industrial functional part manufacturing in various domains such as automotive, medical, aerospace, and consumer goods [3].
- ❖ Prototyping is still expected to be one of the major trends that will not decrease during the 2018-2024 period [3].
- ❖ The industrial printer segment was one of the largest segments which constituted around 77% of the total sales in 2019 and is expected to increase in sales in the coming years [6].
- ❖ There is an increasing trend of using desktop 3D printers for household and other domestic purposes [6].
- ❖ The concept of fab shops is gaining popularity in which on-demand custom manufacturing of the objects is possible [6].
- ❖ In the healthcare sector this technology has prospective applications in developing artificial tissues and muscles [6].



Competition

Direct Competitors

The *Universal 3D Printers* will face direct competition from the following industry players:

FlashForge Finder: This printer makes use of a cold printing deck to make it, even more, child friendly, the printer can print using a thumb drive, wifi, or cloud which offers tremendous flexibility. The price of the product is around \$299 and can pose to be a direct competitor for the U1B-3D which is priced in a similar range. However, the printer does not offer a completely enclosed space as does the U1B-3D unit. It also does not appear to be the most aesthetically pleasing machine to be placed on the desk space.

Monoprice Voxel 3D: This is yet another product that offers superior industry specifications and is priced around \$399.99. The printer offers a completely enclosed space for the printing process and is enabled with a touch screen, 8Gb storage, and Wi-Fi capabilities. The printer contains a heated, flexible, and removable base plate which offers higher usability and allows printing of an object in the range of 150 X 150 X 150 mm. The price of the product is on a higher side, but all of these features are offered by U1B-3D at a lower price range.

Tech X-Smart printer: This is a printer having a premium metal construction with fully enclosed working and offers multiple print material abilities. This printer is available at \$399 and offers good technical specifications over U1B-3D and can be a potential source of competition [7].

Original Prusa i3 MK3S: This is a professional printer that used FDM technology and can print products with the maximum dimensions of 250 X 210 X 210 mm, and it is priced around \$1,208. The printer can print using a wide range of materials including PLA, ABS, PET, HIPS, PP, etc. The printer is an open type printer and may not be suitable for the domestic environment. This can be a direct competitor to the U2A-3D company's product [8].

Zortrax M300 Plus: This is yet another tough competitor that is priced around \$2,990 and offers a built volume of 300 X 300 X 300 mm, uses FDM technology, and can print with specialty materials like Z-HIPS, Z-PETG, Z-GLASS, Z-ESD, Z-PLA, Z-ASA Pro. The company is based

in Poland and the product is offered with a complete ecosystem. The product can be used in functional prototyping, jigs, and fixtures, cases and housings, engineering assemblies, medical, automotive, and other engineering usages. This is a completely closed unit and has an aesthetically pleasing appearance.

Big 60 V2 from Modix: This is another professional printer priced around \$3500 that uses FDM technology and has a much bigger build volume of 600 X 600 X 600 mm. The printer has an option of adding a closed enclosure for protection and can print using PLA, ABS and other plastics. This can be one of the biggest competitors for the U2A-3D product. However, the company is based out of Israel and there is an extra shipping cost which can pose some barriers to enter other countries.

Indirect Competition

This section describes the indirect competition that can be faced from several other potential sources that are being used for making functional prototypes, custom made parts and other devices in which 3D printing is trying to replace.

2D and 3D Sketching: Sketching is one of the most predominantly used forms of prototyping that is used by most of the design studios to begin with as it is the most fastest and the cheapest source of representing the information. But in some design houses, sketching can be the only source of presenting the information and prototype and DFM ready models can never reach the physical prototyping stage before getting into mass production and this can pose as an indirect competition [9].

Paper products: Prototyping can be accomplished by using simple paper art and craft by using simple tools like scissors, paper clips, pins, sticky tape and glue. This method cannot make a high fidelity model but can be enough for the client to get a general idea of the product [9].

Lego Prototypes: Lego can form one of the simplest building blocks of the entire product and has been effectively used for making several complex prototypes that are aesthetically pleasing and take less time to construct. They also offer the possibility of iterating the device while it is being built which is an added feature to the entire design process and can pose as an indirect competitor for the 3D printing industry [9].

Physical mockups: A variety of the materials can be used to construct entire physical mockups of the product using a variety of things like paper, hard board, styrofoam, epoxy resin, paints, metal, glue, etc. This is the most widely used methodology in the design schools and hence can be one of the most powerful indirect competitors in the design industry [9].

Wooden models: Wood is a whole other category to consider when thinking about the modeling involved in any project. There are ample varieties of woods available at the disposal of the design engineer that vary in hardness, appearance, workability, texture, feel, color, whether resistance among other properties and can be carved to remarkable degree. This is an old school technique albeit it is being used in most famous design institutions.



Market Barriers

This section describes some of the barriers to the market entry that are applicable for the new entrants as well as for traditional companies that wish to enter new product markets.

- Some of the old school methodologies discussed in the indirect competitor segment of small and medium-scale design institutes are holding the widespread adoption of these 3D printers [6].
- A particular skill set is required to operate the 3D printer and to conduct regular maintenance. Though the skills can be achieved with some effort the wide-scale adoption can be hindered due to the poor knowledge of the working of the technology.
- The increasing technological advances can make the latest entrants more attractive with better specifications and advanced methodologies.
- The time period required for printing a high fidelity model is substantial and can range from 3-5 hours to tens of hours for printing larger and detailed models.
- The availability of 3D printing as a service from larger and smaller companies is a barrier for purchase for domestic usage since cheaper one-time printing is available.
- The person using for personal or professional usage requires a computer-aided design or CAD software to build a digital version of the product. These software are very expensive and can cost several thousand dollars for a one time purchase and can impact the buying decision of the consumers.
- There is no need as such for a traditional office worker to own a 3D printer as it is for the 2D inkjet printer.
- Also, for an average consumer, there is no particular motivation to use a printer apart from hobby related purposes and the printer can probably be used in the early days of the purchase.
- The material required to print is not very cheap if it is just for hobby purposes and hence can have an effect on the consumer-ready models of the printer.
- The quality of all the 3D printers is not the same and the cheaper printers generally suffer from several product deformations and the customer can produce the same component with traditional manufacturing methods with cheaper cost and better surface finish.

SWOT Analysis

This section describes the strengths, weaknesses, opportunities, and threats to the *Universal 3D Printers* company.

Strength	Weakness
<ul style="list-style-type: none">• Two robust models, one focused on household and hobby purposes and another product on professional and industrial designing.• The price is reasonable as compared to the market offerings.• The product has a fully enclosed structure and inbuilt printing material stock storage which makes it a child-friendly and desktop device.• The product comes with the entire package of software tools and a 24 X 7 customer support system.	<ul style="list-style-type: none">• The technology is rapidly progressing and for 3D printers the better the technology the more favorable the product is, and hence it is a challenge to maintain the competitive advantage for the long term.• The industrial printers requires SLS and DMLS technologies and it is difficult to shift from FDM to these and requires higher capital requirements• An industrial customer base is required for selling industry-grade printers
Opportunities	Threats
<ul style="list-style-type: none">• The overall 3D printing industry is expected to have a phenomenal growth rate of around 20% in North America alone .• The child-safe printers can be effectively marketed as a high-end toy• For new product lines, industrial printers working on the technology of SLS and DMLS are expected to have major growth.• Prototyping remains the major function of the printers and hence the marketing efforts should be targeted towards design schools and engineering colleges.	<ul style="list-style-type: none">• The ever increasing competition is the source of the threat that should be constantly studied.• The traditional prototyping methods discussed earlier pose a substantial entry barrier.• Traditional household consumer does not need a 3D printer for day to day activities.• The material is not cheap• Cheaper printers do not offer high-quality surface finish• Larger printers require considerable space



Potential Customers

Toy Shops: The U1B-3D is a perfect example to be displayed as a high-end toy for a varying age group which can help parents bond with the children while making use of the printer. This would ensure the different opportunities that the children can learn while playing with the printer and can prove to be one of the ultimate STEM-based toys which is a market of its own growing at a rapid rate.

Schools and Learning Institutes: 3D printing is one of the hot study topics which is as interesting as scientific it is in providing a fun learning way to interact with students. Schools and other institutes have started offering coaching classes dedicated to prototyping making use of the 3D printers. The schools can purchase multiple units at once to present in a class structure and can be a potential source of a revenue stream to consider.

Design Studios: The U2A-3D is a perfect fit for the professional usage of 3D printing as it offers excellent aesthetic appearance with having fully enclosed structure and holds the printing stock. Various old school design schools can be given special offers or demo sessions that can be constructed to display the capabilities of the printer and can be potential customers.

Fashion Industry: 3D printing is finding its way in most of the consumer products in the modern world which has the capability to design complex jewelry articles with intricate detail which may not be feasible using traditional manufacturing techniques. Several technological applications are finding its way as wearable technology and this trend is projected to rise in the coming future and this would require custom manufacturing and design of several components that need 3D printing capability.

Manufacturing Industry: High fidelity 3D printing can be used in making the end product which requires minimum post-processing application and can be cost-effective for custom manufacturing operations.

Aerospace Industry: This industry requires high customization for advanced technology and the traditional manufacturing methodologies are not effective in making highly accurate machines and require metal 3D printing capability to manufacture complex parts with high-performance characteristics.



Industry/Trade Organizations

This section describes the most attended additive manufacturing tradeshows which have several thousands of attendees and products are hosted by hundred of company exhibitors. This is traditional marketing and advertising platform used for B2B interactions and is a way to enter any established industry.

IMTS2020: The International Manufacturing Technology Show is one of the premier manufacturing technology show in North America that attracts substantial interest from consumers and company partners. This show exhibits a wide range of technologies and products but also has a variety of companies displaying additive manufacturing related products and technologies. The upcoming show is scheduled in September 14-19, 2020 in Chicago IL [10].

Rapid + TCT: The two industry leaders in 3D events, SME and Rapid News Publications jointly present the event RAPID + TCT. It is known as one of the largest 3D technology events. It is known for product announcements, hands-on exhibits, networking opportunities. More information about the membership and its advantages can be found in the source section [11].

The Association of Manufacturing Technology: This association represents and promotes US-based technologies. It is dedicated to providing services to those who design, build, sell, and service the evolving technologies related to manufacturing. This association owns and manages the IMTS show and provides various opportunities for growing business with consulting services, global support, and trade resources. This is a one-stop-shop for gathering industry intelligence, advocating for manufacturing, and engaging with industry. For more information on membership and contact information refer to the source section [12].

NAMA: National Additive Manufacturing Association helps with issues related with tax, trade, IP protection, R&D tax credit, accelerated depreciation, support with DOD, and funding for manufacturing hubs. The organization helps promote legislative knowledge and protect from governmental actions through collaboration with the growing industry [13].

Conclusion

The industry landscape looks promising for the 3D printing industry as it is prospected to have a substantial growth rate. *Universal 3D Printers* can make use of this opportunity by making the right marketing decision and introducing the product with the most demanded technology. A product targeted towards industrial customers will be more successful than the one targeting towards household and domestic usage. The company should make use of the current value proposition of having an encased transparent canopy and inbuilt material stock storage and market-based on safety and aesthetic design.

Fab shops that offer custom manufacturing on demand are expected to gain popularity and having interviews with such potential customers before launching a new product line is preferable. The major threat can be experienced by the new entrants with high-end specifications and ever-advancing technology. The company should leverage the core competency with the existing customer base and improve its visibility through trade shows and industry associations.

The future of the overall industry looks promising and the right product offering at the right time is sure to bring success to *Universal 3D Printers*.

THE END



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