3d Printing Applications in Creative Advertising Marketing: A Review

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Abstracts: 3D printing as digital manufacturing is considered the multiple aspects of the industry field, especially in advertising. This type of knowledge is based on the concept of a multi-layer fabrication technique called additive manufacturing, which produces physical objects created in 3D software (e.g., Maxon C4D, Autodesk Fusion 360, AutoCAD, Autodesk Maya, etc.) and then transforms the dimensional object to (e.g., G-Code). This article focuses on a question: Is there the importance of 3D printing application techniques, materials, and manufacturing in the field of advertising as a creative tool that can bring atypical formulation in advertising designs and create a new marketplace? They play an active part in promoting the product due to the absence of studies that focus on the presence of 3D printing in the advertising business, especially outdoor ones such as road advertisements or multidimensional wall advertisements. the findings from this study suggest that 3d applications like 3d advertising manufacturing, special materials, or other intelligent fabrication may be influenced by its method and process to a moderate degree as a new marketplace and strategy.

Keywords: 3Dprinting, stereolithography, polymers, 3D Advertising manufacturing, Atypical Design formulation, Brandin.

1. INTRODUCTION

Additive manufacturing in 3-dimensional (3D) advertising makes new markets more effective and draws attention directly to products with high-quality persuasive messages using new tools for building out-of-home advertising. Three-dimensional advertising elements and product displays have mainly attracted the attention of Internet marketing researchers. According to them, 3D elements have been found to enhance consumers' positive responses (Ju and David 2004). 3D printing can be defined as a method of manufacturing known as the European Social Fund (2013), which states 'Additive manufacturing' due to the fact that instead of removing material the process of making a part involves adding material in a series of patterns until the final form is achieved. AM is thus fundamentally different from traditional formative or subtractive manufacturing (Tofail et al. 2018), With the advent of additive manufacturing (AM) the possibilities of digitally fabricating these non-standard shapes have increased substantially. This possibility, though, is obtained at the expense of customized and often time-consuming fabrication settings, raising the need for researching means to produce these continuum structures using regular and affordable 3D printers (Beltran et al. 2021). Advertising manufacturing is a combination of Industry 4.0, as Branger and Pang imply, (2015), "is anticipated to bring incremental changes in a business transaction. It combines physical and digital technologies like robotics, additive manufacturing, advanced materials, high-performance computing, and cognitive technologies (Branger and Pang 2015). Consider this type of design used by different categories of production significantly (e.g., Agriculture, healthcare, the automobile, locomotive, and aviation industries, as well as the materials utilized in 3D printing technologies in the manufacturing business with fast processing.

1.1 Types of 3D Printing in Advertising Manufacturing

The manufacturing side found as usual conventional techniques in advertising structure, made up of collecting parts. Definitely, this new, much-hyped but somewhat unproven manufacturing process must move towards a technology that can demonstrate the ability to produce real, innovative, complex, and robust products (Tofail et al. 2018). As the National Center for Manufacturing Science (NCMS) (2022), in their project, it is currently possible to implement several different types of additive manufacturing (AM) processes that can be very different from one field application to another (Manufacturing Sciences 2022). 3D Advertising benefits from this advanced process that

uses specific applications and material/s. Additive Manufacturing essentially highlights four main components:

- A digital model of the object can vary from a" simple design to a complicated one".
- Material/s that are consolidated from the smallest possible form for example liquid droplets, wire, or powder to make the object.
- A tool for laying materials.
- A digital control system for the tool to lay the material/s layer-by-layer to build the shape of the object (Tofail et al. 2018).

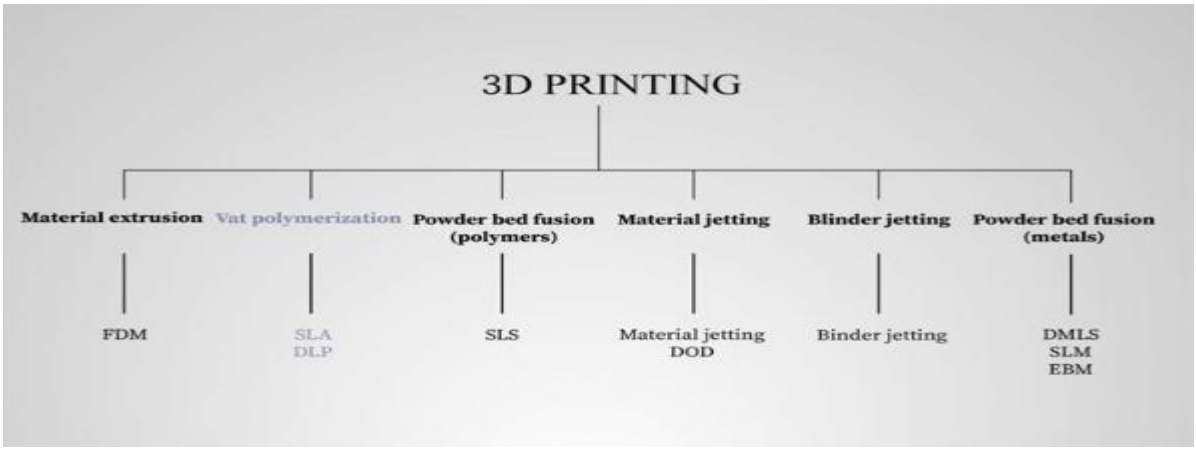

Figure 1. Types of 4D printing in advertising manufacturing. (Adapted from Source. [(Hubs.com, What is SLA 3D printing? 2022).7]).

1.2. Stereolithography (SLA) Process in Outdoor Advertising

3D printing represents a series of flexible additive manufacturing technologies that can accurately construct structures with complex 3D features. It has great advantages in design flexibility, mass customization, reliability, and diversity of compatible materials (Yu, Zhang, and Li 2020). Advertising campaigns have recently been tried in many ways (e.g., 3D Billboards; indoor 3D digital Murals; Outdoor wall ads) to grab consumers' attention and create a new advanced marketplace. Stereolithography is a common and widely used 3D printing process in advertising manufacturing, in this section, the author illustrates the techniques, process, and special materials that define the new face of 3D advertising manufacturing as follows:

1.2.1. Stereolithography (SLA)

In the vat photopolymerization family, stereolithography (SLA) is an additive manufacturing process. SLA, DLP, and LCD are the three primary vat polymerization 3D printing technologies. A light source is used to cure a photopolymer, but the three technologies differ in the following ways. Polymer resins are selectively cured using UV lasers in stereolithography (SLA).

Table 1 The main characteristics of SLA 3D printing are on the substrate of the specific (SLA) automation in small parts manufactured in 3D advertising. Table source (Hubs.com, What is SLA 3D printing? 2022).

Materials	Photopolymer resins (thermosets)
Dimensional Accuracy	± 0.5% (lower limit: ±0.10 mm) – desktop ± 0.15% (lower limit ± 0.01 mm) – industrial
Typical Build Size	Up to 145 x 145 x 175mm – desktop Up to 1500 x 750 x 500mm – industrial

Common layer thickness	25–100 µm
Support	Always required (essential to producing an accurate part)

- Digital light processing (DLP) uses a digital projector as a UV light source to cure a layer of resin.
- Liquid crystal display (LCD) uses an LCD display module to project specific light patterns.
- SLA is one of the most widely used vat photopolymerization technologies. It is used to create objects by selectively curing a polymer resin, layer by layer, using an ultraviolet (UV) laser beam. The materials used in SLA are photosensitive thermoset polymers that come in a liquid form. Patented in 1986, SLA was the first 3D printing technology. And even today, SLA is still the most cost-effective 3D printing technology available when parts of very high accuracy or smooth surface finish are needed. Best results are achieved when the designer takes advantage of the benefits and limitations of the manufacturing process. (www.hubs.com, (accessed July 6, 2022)

Table 2. 3D printing applications/material in Advertising Manufacturing

Printing Techniques	Materials	Advantages	Disadvantages
Stereolithography (SLA)	Polyester/Polycarbonate Polyether Semi-Crystalline	SLA) printing has fine features, smooth surface finish, ultimate part precision and accuracy, and mechanical attributes like isotropy, water tightness, and material versatility (Guide to Stereolithography (SLA) 3D Printing.Formlabs, Accessed July 10, 2022).	High-Cost, Easy to handle but still some parts require attention. It is not environment friendly. Also required Perfect Assembly of the printer, and Needs curing after print (Rajpoot 2021).
Selective Laser Sintering (SLS)	Thermoplastics Metal powder Ceramics	(SLS) has budget-friendly, filament reusable, variety of material Choice, easily portable, and compact design (Pal 2021).	Rough Surface Finishing, Warping is common, Nozzle Clogging, Longer Printing Time, and Layer Adhesion Problem (Layer Shift), (Rajpoot 2021).
Fused Deposition Modeling (FDM)	Amorphous Hydrogels Thermoplastics Ceramics Photopolymers	FDM) has a low-cost budget, color, accessible, composite materials, and accepts open-source designs (Ahangar et al. 2019).	Slow speed, lower resolution, and nozzles impart high shear forces on object cells (Ahangar et al. 2019).
Digital Light Process (DLP)	Ceramics Photopolymers	(DLP) is popular because of its high print speeds, though accuracy is sacrificed in the process. It is limited to photopolymers that often emit odors that can be problematic in an office environment (What is Digital Light Processing (DLP)? n.d.).	It is limited to photopolymers that often emit odors that can be problematic in an office environment (What is Digital Light Processing (DLP)? n.d.).
Multi Jet Fusion (MJF)	Rigid plastics: Nylon PA11, Nylon PA12, PP / Flexible plastics: Estane 3D TPU M95A	Eliminates the need for support structures, prints parts directly in color have good physical, and mechanical properties, and produces a good price-quality ratio (Europe 2019).	limited material options, a rougher surface (Europe 2019).
Poly Jet.	Digital materials- Digital ABS material-Rubber.	(PJ) Produce Realistic Models for 3D Advertising parts/Medical Applications, high accuracy, save %50 of time, Materials Used in Polyjet 3D Printing n.d, (accessed July 10, 2022).	Need to a deep understanding of materials/process.

Stereolithography process is based on the photopolymerization principle of liquid-photosensitive resin (Melchels, Feijen, and Grijpma 2010). Technically in (SLA), a support structure is always necessary. This structure is printed in the same material as the part and must be manually removed after printing. The orientation of that part determines the amount and location of support. It is always recommended that the part is oriented in such a way that it is ample

support all around it.

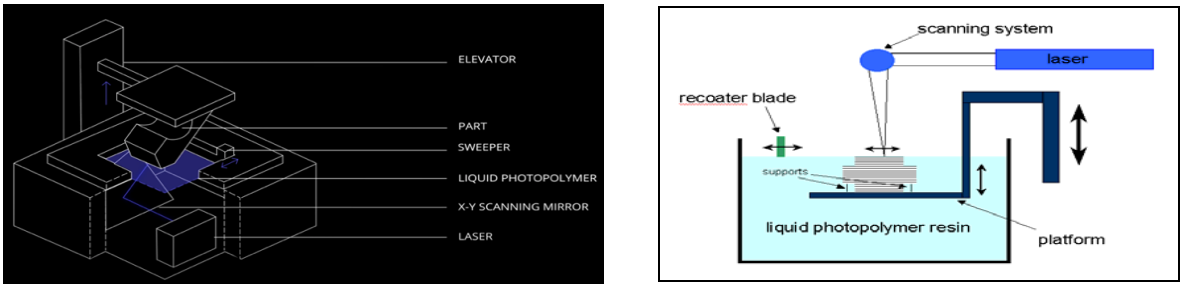

Figure 2. Schematic illustration Stereolithography (SLA) processes contents in manufacturing advertising parts. (Adapted from Source., www.hubs.com, (accessed July 6, 2022) (What is SLA 3D printing? 2022).

1.2.2. Low Force Stereolithography (LFS) in Advertising Industry

According to Pye (2019), “Since existing industrial SLA machines were large and expensive, the company's Form 2 3D printer used a new technology called Inverted Stereolithography (Inverted SLA).” However, it was at the expense of exerting significant forces on the part during printing. The printer accounts for this with heavy calibration but heightened peel forces introduce limitations around materials and build volume (Introducing the Form 3 and Form 3L Powered by Low Force Stereolithography 2019). The parts require sturdy support structures to print successfully (Pye 2019).

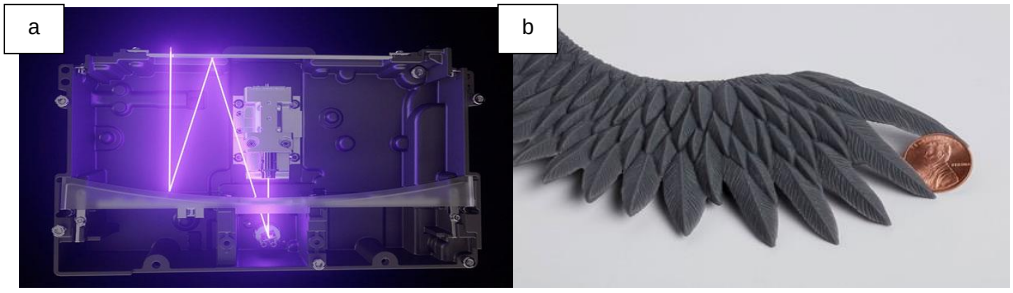

Figure 3. Work principles in 3D advertising manufacturing.

Left side (a) Lower forces deliver consistent part accuracy and surface quality, Right died (b) The Light Processing Unit (LPU) contains a system of lenses and mirrors to deliver accurate, repeatable prints, figure source: Hubs, www.hubs.com, (accessed July 6, 2022) (What is SLA 3D printing? 2022).

2. RESULTS

2.1. 3D Advertising Manufacturing and Marketing

Rapid development, which governs product marketing strategies, links 3D advertising design and manufacturing. Aldo Neri CEO – of Colorzenith (Stepping out in 3D printed style (2019), states that “the uniquely creative out-of-home advertising 3D printing ARMANI 3D Campaign, adds another dimension to advertising and captures the attention of consumers”. The foresight and creative drive to develop innovative campaigns that stop crowds in their tracks by utilizing cutting-edge technologies and ideas. People are compelled to pause for a moment to admire the 3D touches that are included in this campaign. The meticulous attention to detail was essential to accurately represent the Armani brand (Stepping out in 3D printed style 2019). Manufacturing is a competitive industry when it comes to advertising "the cost of production remains competitive”. Products made using additive manufacturing (AM) can take off in the marketplace if they satisfy their intended properties through managed-to-handle or metrology (Tofail et al. 2018). The interconnectedness of the market, manufacturing, materials, and 3d advertising design is demonstrated in Fig 4.

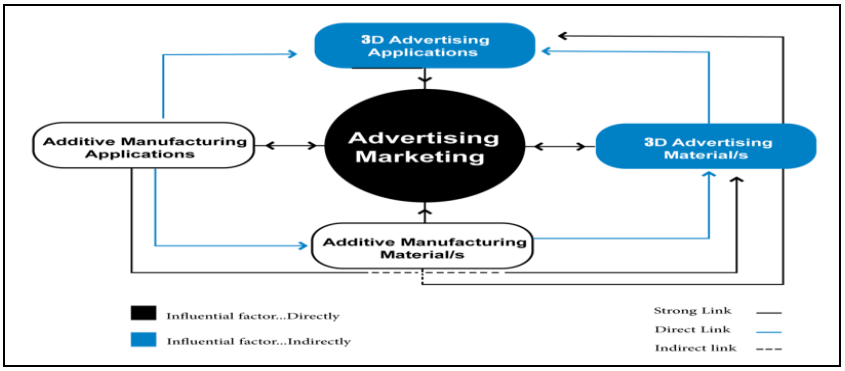

Figure 4: Relation between additive manufacturing (AM) and marketing of 3D advertising (MDA).

The author illustrates the link between the marketing aspect and classification with the added technology of 3D advertising by referencing the role of support and its importance to the consumer. Fig (4) depicts the relationship between the marketing system and the new 3D printing mechanism. Additive manufacturing (AM), as shown in Fig5, is revolutionizing both the way and the products we create. As Seepersad (2014), noted the designers seek professional characteristics and economic products for a number of reasons: “It is possible to create extremely complex internal product architectures that improve a product's functionality by adding material only where it is needed, layer by layer”, and utilize final aspects of creativity in advertising manufacturing.

Figure 5. 3D printing applications and materials in advertising manufacturing.

Note: The 3D printed components of the billboard—a shoe and partial leg—were 3D printed by Color Zenith using its large-format Massivit 3D printer. Massivit, an expert in large-format 3D printing offers two 3D printers, the Massivit 1800 with a build volume of 145 x 111 x 180 cm and the Massivit 1500 with a capacity of 147 x 117 x 137 cm. Source: Massivit.com.

2.2. From Conventional Strategy to Manufacturing Strategy of the Construction in 3D Ad

Davids' study (2016) conducted that, “3D printing continues to be an area of interest for the global construction, architecture, and engineering fields, and manufacturers and suppliers of the technology have been investing significant amounts of capital into the research and development of new methods and systems for the industry to use", especially in advertising manufacturing, based on constant comparative analysis in 3D printing marketing. Therefore Kafle et al. (2021), pointed out that, “more than 60% of AM studies are focused on polymer printing.”

The polymers can be 3D printed with all three (i.e., solid-based, powder-based, as well as liquid-based) AM techniques (Stansbury and Idacavage 2016). Kafle et al. (2021), confirmed that Fused deposition modeling, also known as FDM, is the most common and widespread solid-based 3D printing technique used to create polymer parts. A vat-based technique, SLA, is another widely used early AM method for creating polymer parts by processing the polymeric liquid as the primary base material, while SLS is a more prominent method for producing polymer parts using polymeric powders.

3D printing and hybrid additive/subtractive manufacturing are several technologies that offer opportunities for the construction industry and offer a new tool for project managers. Increased construction flexibility is one of the key

advantages of 3D printing. It is essential to understand the characteristics of the industry in order to be able to take advantage of the benefits that the technology offers. Research interest in 3D printing for construction has increased significantly in recent years (Besklubova, Skibniewski, and Zhang 2021).

Tofail et al. (2018), found out that, “Metrology, the science and act of measuring, is essential for additive manufacturing (AM), not only for reasons of technical confidence but also because of the market's demand for parts made using AM to perform consistently and reliably. It is anticipated that metrology will soon become a legal and financial requirement for AM products that will be sold in the market.” However, the success of added manufacturing lies in how good the object (e.g., product, or 3d object) factory is in serving its intended use in the market. Translating AM's superiority and comfort in creating shapes and structures into useful products is critical to its adoption in industrial preparation, extending to the 3D advertising industry (Grace 2016).

Table 3. The implication of barriers and enablers on implementation of 3D printing in advertising manufacturing. Table source (Olsson, Arica, and Madrid 2021).

Previous experiences with 3D printing.	3D printing characteristics	Implication for implementation of 3D printing.
A mismatch between market needs and Innovation.	3D printing will facilitate mass customization in the construction industry High skilled labor is required for 3D printing operation.	As mass customization has high demand in the construction industry in "advertising", this feature of 3D printing technology should be leveraged in improvement projects.
Lack of skilled workforce in the "advertising" market for innovation implementation.	High cost of 3D printing technology, and long process.	High-skilled labor is a big challenge to implement the 3D printing technology on large scale. Training and education initiatives are required especially for atypical designs.
Initial high cost and "skills" of the innovation.	High cost of 3D printing Technology and “special materials in advertising ”.	Especially, the SMEs will have difficulties affording the 3D printing technology. Actions to improve the technology and reduce its cost of it should be taken.
Risk in adopting new Technology.	The 3D printing technology is not mature for large-scale usage.	High risk is involved for large construction companies to use this technology on a large scale. New risk-sharing models will be of importance.
Non-profitability.	3D printing has the capability of waste reduction, cost reduction, and time reduction.	The use of 3D printing will result in more productive and profitable projects, which should be escalated for wider implementation ", especially in the advertising field".
Multiple stakeholders create challenges for collaborative implementation of the innovation.	Multiple stakeholders are involved in the implementation of 3D printing.	implementation of 3D printing technology requires a common understanding and interest within the whole construction value chain.

2.3. Atypical Design formulation:3Dimensional advertising and Manufacturing in Branding Marketing

“Atypical design is particularly important for its aesthetic responses, which are the defining characteristic of creativity” (Ali 2022). According to the schema-copy-plus-tag model (SCT), Recognition memory performs more effectively. First, recognition of "design" arguments that are atypical of the generic schema and are actually presented in the "3-dimensional advertising form" message should be relatively accurate, because these items are distinctively tagged during the message encoding (Hunt, Kernan, and Bonfield 1992), It is much easier and more effective to communicate a message visually when advertising is done in 3D, 3D printing is important because of this interconnectedness.

According to Kafle et al. (2021), confirm that “Many product design services have great ideas and understand how to transform new concepts into reality”. As agreed with Landwehr (2013), knowing what atypical design process is required, what new 3D materials can be obtained, and how the products can benefit consumers, in order to create an atypical product 3D printing design and idea. Manufactured 3D ads can be constructed based on their complexity, material customization, and amount of product marketing, regardless of how they were manufactured.

CONCLUSION

Overall, this study suggests that the panorama of 3D printing in the industrial business is explored in-depth in this review. At the moment, 3D printing technology is making its way into the manufacturing industry, and it has a lot of advantages for individuals, businesses, and the government. With its small samples and different costs in the advertising field, as a result, more data is required to make progress on advertising strategies to improve the use of 3D printing technology. More knowledge regarding 3D printing technology will aid companies and governments in upgrading and improving the technology's infrastructure. As a result, the purpose of this article is to answer the study question within provide an overview of the many types of 3D printing technologies, materials used in 3D printing technology in the manufacturing business, and 3D advertisements (e.g., printing, technology, applications, and implementation) In the future, researchers can conduct studies on the many types of 3D printing machines as well as the appropriate materials to use in advertising production.

ABBREVIATIONS

Table 4. Source (Kafle 2021)

AM	Additive Manufacturing.
CAD	Computer-Aided Design.
ASTM	American Society for Testing and Materials FDM Fused Deposition Modelling.
LOM	Laminated Object Manufacturing.
SLS	Selective Laser Sintering.
SLA	Stereolithography
STL	Standard Tessellation Language
FFF	Fused Filament Fabrication
PLA	Polylactic Acid
SLA	Selective Laser Sintering
MDA	Marketing of 3D Advertising

DECLARATIONS

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CONFLICT OF INTEREST

The authors declare that she has no financial interests (conflict of interest).

DATA AVAILABILITY

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

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