

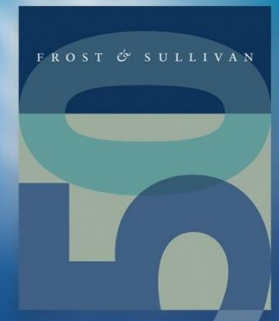
# Advanced Manufacturing Alert (TechVision) 3D Printing in the Fashion Industry

Impact of 3D Printing on the Fashion Industry



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# Innovations in 3D Printing in the Fashion Industry

# 3D Printing Using Technology

## Nervous System–Kinematics 3D Printed Dress

### Tech. Profile

A Massachusetts-based design studio, Nervous Systems, has designed and created a new kinematic dress using three-dimensional (3D) printing technology. The dress was inspired by natural elements such as scales, flowers, petals, and feathers. The dress was printed using the company's own Kinematics textile technology. The different elements of the dress are interconnected and overlap each other. The elements have shell-like structures and are 3D printed.

### Competing Aspects

Kinematics textile technology developed by the company allows users to 3D print a dress as a single folded piece using flexible material. The company has used a Formlabs Form-2 desktop 3D printer for prototyping different elements of the dress. The dress itself was printed using Shapeways' 3D printing service via Selective Laser Sintering technology.

### Innovation Attributes

Nylon was the main material used to 3D print the dress and to obtain the color. The prints were submerged in red dye bath. The dress consists of 1600 pieces, which are interconnected using 2600 hinges. The petals in the dress camouflage the hinges. The dress is 3D printed fully assembled.

### Wide-scale Adoption

Nervous Systems has plans to introduce more dresses in the same line and will be commercialising these dresses over the near-term. Wider-scale adoption of 3D printed clothing can be expected by 2020.

### Market Opportunity

- 3D printer manufacturers
- Material manufacturers
- Lifestyle
- Clothing brands
- Fashion accessories

### Technology Convergence

By using additive manufacturing technologies for producing clothes and dresses, designers and clothing brands have much more design creation and customization freedom when compared to traditional manufacturing processes. This will also open up many new applications in the lifestyle market and other domains mentioned above in the near future.

### Market Entry Strategies

Nervous Systems designed their latest 3D printed dress for exhibiting at the the Museum of Fine Arts (MFA) in Boston from March 6 to July 10th, 2016. The company's jewelry collection which is inspired by the natural elements structure of the dress will also be sold at the exhibition.



# Fibonacci Sequence 3D Printed Dress

## threeASFOUR–Harmonograph and Pangolin Dress

### Tech. Profile

threeASFOUR, a clothing brand located in New York, uses cutting-edge technology to design and manufacture modern, fashionable clothes. The company has collaborated with a famous designer, Travis Fitch, and a 3D printing company, Stratasys, to design and unveil two dresses, the Harmonograph and Pangolin. The dresses were inspired by different biological forms and textures.

### Competing Aspects

The team used Stratasys' polyjet Objet500 Connex3 3D printer and nano enhanced elastomeric 3D printing material. The acrylic-based material also gave the dresses more flexibility, rigidity, and durability. The dress was designed to mimic the Fibonacci sequence and encircles the body in three spirals.

### Innovation Attributes

threeASFOUR has developed a new collection called Biomimicry which will showcase extraordinarily designed dresses manufactured using 3D printing technologies. The Pangolin consists of 14 different pattern pieces which are interlocked and connected to act an overall skin for the wearer. The main feature of this dress is that it can stretch in four-dimensions according to the body type of wearer.

### Wide-scale Adoption

threeASFOUR is adding more designs and models to its collection. The clothing line has opportunities to be commercialized over the near-term. Stratasys' nano enhanced elastomeric material is slated for commercial availability in 2016.

### Market Opportunity

- 3D printer manufacturers
- Material manufacturers
- Lifestyle
- Clothing brands
- Fashion accessories

### Technology Convergence

In the future, it is expected that consumers will be able to design and print their own dresses and other apparel using household 3D printers, which would make such printers more ubiquitous. This convergence is also expected to have a high impact on the fashion industry.

### Market Entry Strategies

threeASFOUR showcased both the Harmonograph and Pangolin dresses at their fall/winter runway show which was held on 15th February 2016 at Milk Studios, New York as part of the New York Fashion Week. The company was also awarded the Fashion Design Award given by the Cooper-Hewitt Smithsonian Design Museum for 2016.



# 3D Printed Dress with LEDs and Optical Fiber

## LED Sci-fi 3D Printed Dress

### Tech. Profile

3D World magazine collaborated with Aiman Akhtar, founder of the 3Dsmiths 3D printing services, to develop a sci-fi, futuristic 3D printed dress. Aiman scanned the model's body to develop the dress to fit perfectly. Each component of the dress was designed using ZBrush software.

### Wide-scale Adoption

The collaboration between 3D World magazine and Aiman Akhtar proved that 3D printing technology can be used to design next-generation dresses. 3D printing is expected to make its mark in fashion design by 2020.

### Market Opportunity

- 3D printer manufacturers
- Material manufacturers
- Lifestyle
- Clothing brands
- Fashion accessories

### Competing Aspects

To achieve the sci-fi look for the dress, the designer integrated electronics such as LEDs and fiber optic cables to produce lighting effects, which enhanced its uniqueness. To achieve minute details, he used a Formlabs Form 1 + desktop stereolithography 3D printer to 3D print different components of the dress.

### Innovation Attributes

- The 3D printed dress's largest innovation attribute is its design, uniqueness and its sci-fi appeal. Aiman Akhtar's in-depth knowledge of additive manufacturing technologies and 3D modeling has enabled him to create this one of a kind sci-fi dress.
- By using 3D printing technology, the designer was able to incorporate new, creative designs, which were not feasible using traditional designing methods.



### Technology Convergence

The design of the sci-fi dress is proof to demonstrate the high degree of advanced technology convergence of 3D printing and fashion design, which will impact the fashion industry in the near future. 3D printing will pave the way for the development of new and advanced applications in the above-mentioned industries, which were not possible using conventional and traditional processes.

### Market Entry Strategies

3D World magazine is anticipated to collaborate with other fashion designers to design and manufacture more exquisite dresses using additive manufacturing technologies. Similarly Aiman Akhtar will also be designing and showcasing different styles of 3D printed dresses in fashion exhibits and shows. This strategy is expected to create more awareness about the use of 3D printing technology in the fashion industry.

# Moth Wings Inspired 3D Printed Dress Sponsored by Microsoft

## Ohne Titel- FW Collection

### Tech. Profile

Ohne Titel is a womenswear brand which has incorporated 3D printing for designing and manufacturing a clothing line using different combinations of materials. The company has also collaborated with Shapeways to 3D print clothing according to their designs. The design of the whole fall winter collection is inspired by the texture and color of moth wings. The very detailed designs cannot be achieved by traditional processes, therefore, the designer used Shapeways' 3D printing services to print the designs and other components. Microsoft Corporation has sponsored Ohne Titel for developing this 3D printed collection.

### Competing Aspects

Shapeways used a semi-transparent translucent filament called Frosted Detail Plastic material to print the pieces and components of the dress. The pieces were put together using the traditional crochet/knitting techniques and 3D printed closures. Shapeways has used stereolithography technology to achieve minute details and high precision.

### Innovation Attributes

- Though most of the components were 3D printed by Shapeways, Ohne Titel still used traditional knitting and stitching processes to make the clothes more durable and flexible.
- The 3D printed links are very light in weight and are assembled in such a way that they resemble moth's wings.

### Wide-scale Adoption

Potential for commercialization of the 3D printed clothing collection in the near future.

### Market Opportunity

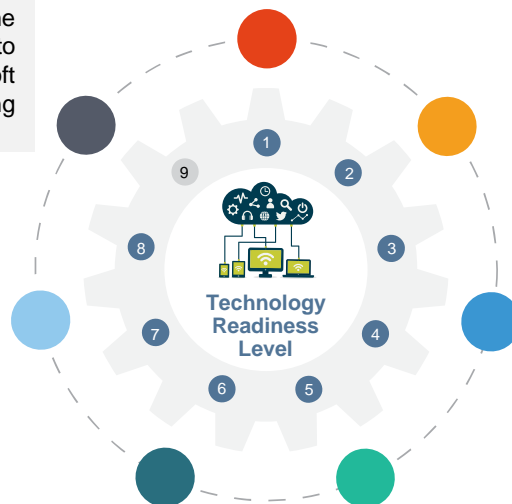
- 3D printer manufacturers
- Material manufacturers
- Lifestyle
- Clothing brands
- Fashion accessories

### Technology Convergence

This proves that additive manufacturing technologies can also be used for designing and manufacturing normal wear for outings and to be applied to conventional processes (such as crochet techniques). By using 3D printing, both the designer and Shapeways were able to experiment with different materials or techniques. This technology convergence is sure to pave the way for various new applications in the above-mentioned markets.

### Market Entry Strategies

Ohne Titel showcased this FW collection at the New York Fashion Week for Fall/Winter 2016 which took place between February 11<sup>th</sup> – 18<sup>th</sup> at New York, USA. A company founder has intimated that within the next 10 years, unimaginable new techniques and methods would be possible for fabrication of clothing by using 3D printing technology.



# Strategic Insights

## Target Markets—Near-, Medium-, and Long- Term

- In the near term, 3D printing is expected to be adopted by fashion designers and brands for prototyping and modeling new, unusual, and very avant garde designs which were not possible to achieve using traditional dress manufacturing methods.
- In the medium term, more fashion shows will exhibit various collections of designs and dresses that were 3D printed using new or enhanced materials which were not conventionally considered for manufacturing clothes.
- In the longer-term, we can anticipate designers and clothing brands to install 3D printers in their showrooms. Customers can go to the brand stores to 3D print clothes according to their requirements.

## Competitive Landscape

- At present, high activity in relation to 3D printing technology being used for designing and manufacturing dresses is taking place in the North American region. The technology development for the fashion industry has had a high impact, whereas the adoption footprint has not yet had as strong an impact.
- The European region is also slowly researching and implementing 3D printing technology for designing dresses, but it is not as active as the North American region. The technology development and adoption impact has been fairly limited.
- The APAC region is yet to significantly enter this niche market. By 2020, this region is also anticipated to enter this market.

## Driving Forces

- Easy design and prototyping
- Use of new materials which were not traditionally used
- Design freedom
- Cost and time for designing and manufacturing is reduced tremendously
- Smart fabrics can be integrated in the designing and manufacturing stages.
- Ability to create customized clothing on a mass-manufacturable scale

## Entry Barriers

- High implementation, research and development cost
- Acceptability of the end-user to use 3D printed clothes
- Scalability of the technology to large-scale manufacturing
- Cost of the designed clothes will be high initially.
- The brand and the design can be easily duplicated and sold in the aftermarket.
- Need to show the 3D printing can be used to create beneficial, lucrative fashion designs rather than strictly serve as a novelty factor



# Key Patents

No.	Patent No.	Publication Date	Title	Assignee
1	WO2015120271	13.08.2015	Customized, Wearable 3d Printed Articles And Methods Of Manufacturing Same	Printer Tailored, LLC
	<p>The present invention relates to three dimensional (3D) printed garments and any wearable article, as well as to processes and methods of manufacturing the same. Image information obtained from a subject, for example, images and information related to a subject's body or body part(s) is used to generate a garment or wearable object with a customized fit. In particular, the present invention provides the collection of a subject's data (e.g., using image acquisition devices, methods and software), and use of the data to create a model (e.g., virtual model) that in turn is used to create a subject specific article of clothing or other wearable object.</p>			
2	CN104273678	14.01.2015	Clothes with three-dimensional printing patterns capable of being seen with naked eyes	Zhongshan Shaxi Town Xinshunyi Printing Embroidery Factory
	<p>The invention discloses clothes with three-dimensional printing patterns capable of being seen with naked eyes and belongs to the technical field of printing clothes. The clothes comprise a clothes body 1, a printing pattern layer 2 subjected to 3D (three dimensional) effect treatment is arranged on the clothes body 1 and provided with a three-dimensional elastic columnar lens grating layer 3 of the printing pattern layer 2 capable of being seen with naked eyes, and the printing pattern layer 2 and the elastic columnar lens grating layer 3 are adhered by a colorless and transparent adhesive layer 30. The elastic columnar lens grating layer covers the 3D printing pattern layer on the clothes body, the printing patterns on the clothes can be seen with naked eyes and can show high spatial layering sense in the three dimensional relation of top and bottom, left and right and front and back, new ideas and innovation are brought for clothes design, and aesthetic value and added value of the clothes are improved.</p>			

## Key Patents (continued)

No.	Patent No.	Publication Date	Title	Assignee
3	CN10361249	05.03.2014	3D (three-dimensional) color printing process for polyester piles	Liang Yunfei
	<p>The invention discloses a 3D (three-dimensional) color printing process for polyester piles. The 3D color printing process includes steps of (1), designing patterns and selecting and laying colors; (2), selecting raw materials; (3), performing heat setting on gray cloth; (4), performing burn-out on the gray cloth and printing the gray cloth; (5), ageing the gray cloth at a high temperature and coloring the gray cloth; (6), washing the gray cloth; (7), setting finished products. The 3D color printing process has the advantages that printing and burn-out are integrated, so that an effect of printing the patterns on polyester lint can be realized, and the polyester lint is layered in a concave-convex and ordered manner; current requirements on small-lot multiple designs and patterns can be met, test samples are low in cost, and the product development speed is high.</p>			
4	CN103421387	04.12.2013	Novel 3D Silk-screen Printing Ink	Guangzhou Honesty Polymer Material Co. Ltd.
	<p>The present invention relates to the field of furniture. Disclosed is a method for realizing 3D visual effect on furniture surface using 2D image, comprising: when three-dimensionally decomposing 2D planar image, determining the different scaling ratio according to the corresponding different positions of each decomposed 2D pattern on the outer surface of a sofa; scaling the decomposed 2D pattern according to the corresponding scaling ratio, and obtaining the decomposed 2D pattern waiting to be printed; respectively printing the scaled decomposed 2D pattern waiting to be printed using an inkjet printer/printing press on a cloth consisting the decorative sofa upholstery cloth; and then conventionally cutting, sewing and reprocessing the cloth to make into sofa covers or sofa cover products. Better correspondence of each part of the entire image seen from an optimal visual observation point with the original planar 2D image is ensured via the corresponding scaling of each decomposed 2D pattern, allowing the displayed image to present a lifelike visual effect that better approximates the original 2D planar image. The present invention can be widely used in every cloth production field relating to furniture.</p>			

# Industry Interactions

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