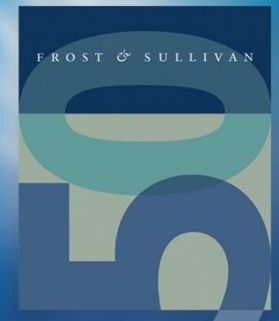


Advanced Manufacturing Alert (TechVision)

3D Printing in the Sports Industry

“Impact of 3D Printing on the Sports Industry”



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Contents

Section	Slide Numbers
<u>Innovations in 3D Printing in the Sports Industry</u>	3
<u>GuardLab–3D Printed Mouth Guard</u>	4
<u>LLNL and Autodesk–Next Generation 3D Printed Sports Helmet</u>	5
<u>Under Armour–UA Architech Shoes</u>	6
<u>University of Quebec in Montreal (UQAM)–3D Printed Hockey Puck for Visually Impaired</u>	7
<u>Analyst Perspectives</u>	8
<u>Key Patents</u>	9
<u>Industry Interactions</u>	11

Innovations in 3D Printing in the Sports Industry

3D Printed Protection Gear

GuardLab–3D Printed Mouth Guard

Tech. Profile

GuardLab, a custom mouth guard manufacturer, has partnered with Ultimate Fighting Championship (UFC) to manufacture perfect fitting mouth guards for athletes and fighters (for example, mixed martial arts) . The custom neuromuscular mouth guards are printed using high-resolution 3D printers.

Competing Aspects

The athlete is first subjected to a bite optimization test from which the entire alignment of the jaw and teeth is obtained.

Then using GuardLab's Alignment Repositioning Cushion (ARC) technology, the teeth and jaw position and alignment are designed in such a manner that the guard will cushion any impact and at the same time maximize air flow to the mouth during breathing. By using a 3D scanner, the mouth guard is then 3D printed.

Innovation Attributes

GuardLab uses a MakerBot (acquired by Statasys) 3D printer to first print the mold of the mouth guard. The company also has certified dentists to examine and 3D scan the athlete's teeth and jaws to ensure perfect fit, accuracy, and comfortability.

Wide-scale Adoption

Mouth Guard's range of protective gear is used by fighters and athletes across the sports industry. Custom made mouth guards can have a huge impact in the near future. A wide-scale adoption of these mouth guards can be expected to happen by the end of 2017.

Market Opportunity

- 3D printer and material market
- Sports market
- Medical market
- Protect gear and equipment market

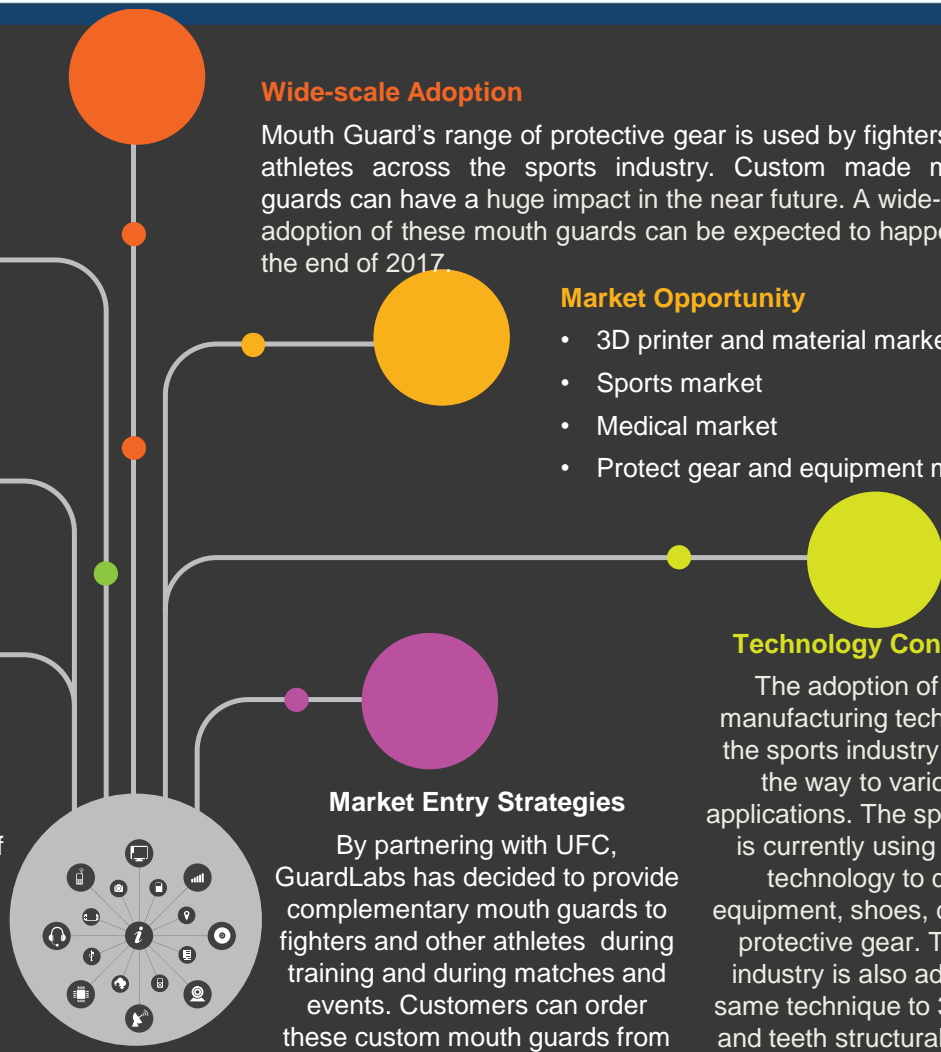
Technology Convergence

The adoption of additive manufacturing technologies in the sports industry has paved the way to various new applications. The sports industry is currently using this novel technology to develop equipment, shoes, clothes, and protective gear. The dental industry is also adopting the same technique to 3D print jaw and teeth structural molds and even dencers as required for the patient.

Market Entry Strategies

By partnering with UFC, GuardLabs has decided to provide complementary mouth guards to fighters and other athletes during training and during matches and events. Customers can order these custom mouth guards from through the company's Website.

Technology Readiness Level



3D Printed Sports Protective Gear

LLNL and Autodesk–Next Generation 3D Printed Sports Helmet

Tech. Profile

Lawrence Livermore National Laboratory (LLNL) and Autodesk Research have partnered to intensively research 3D printed advanced materials and at the same time study the microstructure of various advanced materials using Autodesk software. This research is mainly conducted to 3D print next generation protective helmets using advanced materials and additive manufacturing technology.

Competing Aspects

The research team will be arranging different advanced materials at a micro- and Nano level to improve the design and structural performance of the materials using design architecting and material modelling technologies. By doing so, the team will be able to create a material with complex microstructures and use 3D printing technique to manufacture the helmet pads.

Innovation Attributes

Traditionally, helmet pads are manufactured using foam and pads, but by using a material with a structure that has been arranged at a micro level, the helmet will provide better protection and at the same time expand more energy flow during impacts.

Wide-scale Adoption

By using advanced materials and additive manufacturing technologies, the overall performance, grade, standard, and quality of the helmet will be very high when compared to the helmets in the market. With safety equipment given more importance across the sports industry, this new product can be anticipated to begin to have opportunities for adoption by the end of 2018.

Market Opportunity

- 3D printer and material market
- Sports market
- Military and defence market
- Aerospace market
- Space market

Market Entry Strategies

Autodesk has agreed to a 18-months Cooperative Research and Development Agreement (CRADA; which began in 2015) with Lawrence Livermore National Laboratory. The helmets will also be developed in different versions according to the sports activity they will be used for.

Technology Convergence

Using additive manufacturing technologies for designing and manufacturing crucial safety equipment will pave way for new products and applications across the above mentioned industries. The technology convergence between additive manufacturing and advanced materials is destined to impact many industries in the coming years.

Technology Readiness Level

1 2 3 4 5 6 7 8 9

3D Printed Sports Shoe

Under Armour- UA Architech Shoes

Tech. Profile

Under Armour, a company that manufactures sports apparel and sports gear, after research and development for two years, has used 3D Systems' Selective Laser Sintering technology, to 3D print the mid-soles of a limited edition all-purpose performance shoe called UA Architech. The shoe was designed using Autodesk's designing software.

Competing Aspects

Under Armour chose 3D printing technology since it wanted to produce a shoe, which will have significant flexibility and cushioning ability. Under Armour created a lattice weave structure on the heel to achieve this. If traditional injection molding process had been used for creating the shoes, the company would have had to invest heavily in new tools and machinery. However, by using 3D printing technology, it was able to cut down on tooling cost and manufacturing time.

Innovation Attributes

A combination of polymers and elastomers was used to print the lattice-structure heel of the shoe. By using these materials, the team was able to achieve the required structure and at the same time provide cushioning and comfort.

Wide-scale Adoption

Under Armour sold 97 pairs of the limited edition shoes on March 18th 2016 and is planning on releasing new 3D printed shoes by the end of 2016. Wide-scale adoption of the UA Architech shoes can be expected by the end of 2017.

Market Opportunity

- 3D printer and material market
- Sports market
- Lifestyle market

Technology Convergence

Major sports companies are adopting additive manufacturing technology for 3D printing apparel, gear, and shoes. The main reason is the design freedom this technology offers and the chance to test new advanced materials. The adoption of additive manufacturing technology by the sports industry will increase in the near future.

Market Entry Strategies

Competing companies such as Nike, Adidas, and New Balance have already 3D printed shoes but failed to commercialise them. Even though Under Armour was the last to 3D print shoes, it commercialised and sold these shoes on its Website.

Technology Readiness Level

1 2 3 4 5 6 7 8 9

3D Printed Hockey Puck

University of Quebec in Montreal (UQAM)–3D Printed Hockey Puck for Visually Impaired

Tech. Profile

The Owls of Montreal is a visually impaired hockey team from Canada. The team wanted to develop a special electronic hockey puck, which would emit a specific sound when it is in air or immobile. The hockey team then collaborated with the University of Quebec in Montreal to develop the new hockey puck which is similar in specification of a regular puck used by the visually impaired.

Competing Aspects

The research team from the university used 3D modelling to first design the puck. Since the puck needed to be integrated with audio electronics, the research team had difficulties in finalizing the puck's casing material. The team had to consider factors such as cold, humidity, and moisture (which is produced while playing ice-hockey). In addition, the puck had to be strong and protect the audio electronics when experiencing force when being hit. Polyurethane material was used to address this challenge.

Innovation Attributes

After deciding on the material, the team used 3D printing technology to 3D print the casing of the puck. The audio electronics integrated inside the puck will play different sounds indicating various movement and positions.

Wide-scale Adoption

At present, the special puck is in the prototyping stage. The research team would like to partner with a plastics company, which is capable of plastic injecting these pucks at a higher volume. The research team has also started a crowd funding campaign for further developing the puck to Paralympics standards.

Market Opportunity

- 3D printer and material market
 - Sports market
 - Microelectronics market

Technology Convergence

The sports industry is able to develop and integrate new designs and innovations to cater to the need the requirements of different sports by using additive manufacturing technologies. The technology convergence between microelectronics and additive manufacturing will pave the way for creating new applications in the sports industry.

Market Entry Strategies

The research team has been working on improving the design of the puck. The system would incorporate an accelerometer and sound generator to create sounds of different frequencies based on the amount of force hitting the puck. The researchers hope that the specially developed puck can be used in the Paralympics.

Technology Readiness Level

1 2 3 4 5 6 7 8 9

Strategic Insights

Target Markets–Near-, Medium- & Long- Term

- In the near term, 3D printing is expected to be widely adopted by the sports industry for designing and rapid prototyping of gear, wearables, and equipment. This allows companies to efficiently experiment with new and advanced materials, which was not so easy or possible when using traditional manufacturing process. Logical 3D printing technologies for sports gear or products include fused filament fabrication and selective laser sintering.
- In the medium term, more products that are custom printed according to the athlete's requirements and possess abilities to enhance the athlete's overall performance will be printed using additive manufacturing technologies.
- In the long term, 3D printed sports goods and gear will be commercialized and are anticipated to find significant wide-scale adoption across many regions. This might also pave the way for sports outlets to install and implement 3D printing service outlets that can print custom designs within a few hours.

Driving Forces

- Easy designing and prototyping
- Ease of customization to suit specific individuals
- Use of new advanced materials to print sports clothing, gear, and goods.
- Custom manufacturing of wearables, gear, and kits according to the athletes' build and requirements.
- Precise, accurate, and custom gear can be printed for athletes with disabilities for improving their overall performance abilities.

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 sports industry has a high impact intensity, whereas the adoption footprint may need some time to make a strong impact.
- While the European region is also researching and implementing 3D printing technology for 3D printing apparel and gear, it is not as active as the North American region. The technology development and adoption impact is low here.
- The APAC region not yet significantly entered this niche market. By 2020, this region is expected to be more engaged in this market.

Entry Barriers

- No scalability options for large scale manufacturing of the products
- Availability of limited material options. The traditionally used materials for manufacturing equipment, gear, and goods are yet to be made highly compatible with 3D printers.
- Increased chances of counterfeit products entering the market and affecting the adoption of branded products.

Key Patents

No.	Patent No.	Publication Date	Title	Assignee
1	US20160052297	25.02.2016	Image correction with 3D printing	NIKE Inc.
	<p>Methods and systems are disclosed for three-dimensional printing directly onto an article of apparel. Disclosed is a method and system for direct three-dimensional printing onto an article of apparel, including receiving an undistorted three-dimensional pattern for display on the article, the undistorted three-dimensional pattern configured for placement on an irregular three-dimensional surface; creating a predistorted three-dimensional pattern from the undistorted three-dimensional pattern for printing onto a simple three-dimensional shaped object; receiving the predistorted three-dimensional pattern in a three-dimensional printing system; and printing the predistorted three-dimensional pattern onto the article.</p>			
2	US20160039162	11.02.2016	Injection molding systems and methods for forming materials used in footwear and materials manufactured by said systems and methods	New Balance Athletic Shoe Inc.
	<p>The invention relates to systems and methods for creating a foamed part. An example method includes providing a polymer processing system, providing a mold having at least one expandable mold cavity in fluid communication with the polymer processing system, mixing polymeric material and blowing agent within the polymer processing system to produce a unfoamed mixture, injecting a volume of the mixture of polymeric material and blowing agent from the polymer processing system and into the expandable mold cavity, and expanding the mold cavity to expand the unfoamed mixture within the mold cavity and form a foamed preform. Thereafter, the foamed preform may be inserted into a compression mold to press-form the foamed preform into a finished part.</p>			

Key Patents (continued)

No.	Patent No.	Publication Date	Title	Assignee
3	US20160000187	07.01.2016	Automated strobels printing	NIKE, Inc.
<p>A machine moves shoe strobels to a camera or scanner where images of the strobels are captured. Using the images, a computing device instructs a printer how to mark guidelines within a threshold distance of each other on the strobels that signify strobels sewing lines for different shoes models and shoe sizes. Cross-sectional lines may also be printed on the strobels to aid in error-checking guideline marking. Unmarked strobels are stacked in a loading compartment, sometimes in pairs—e.g., right and left shoe strobels. The unmarked strobels are transferred to a conveyor that brings the strobels to the camera or scanner and the printer. After guidelines and/or cross-sectional lines are added to the strobels, the marked strobels are stacked in a compartments housing other marked strobels.</p>				
4	WO2015102774	09.07.2015	3D printed golf ball core	NIKE INNOVATE C.V.
<p>A method of forming a golf ball includes forming a core using a 3D printer, and molding a cover in a surrounding position over the core through at least one of compression molding and injection molding. The core may be formed by printing a first core portion, printing a second core portion, and fusing the first core portion with the second core portion to form the core. Each of the first and second core portions may respectively include a plurality of concentric shells that are sequentially constructed.</p>				

Industry Interactions

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