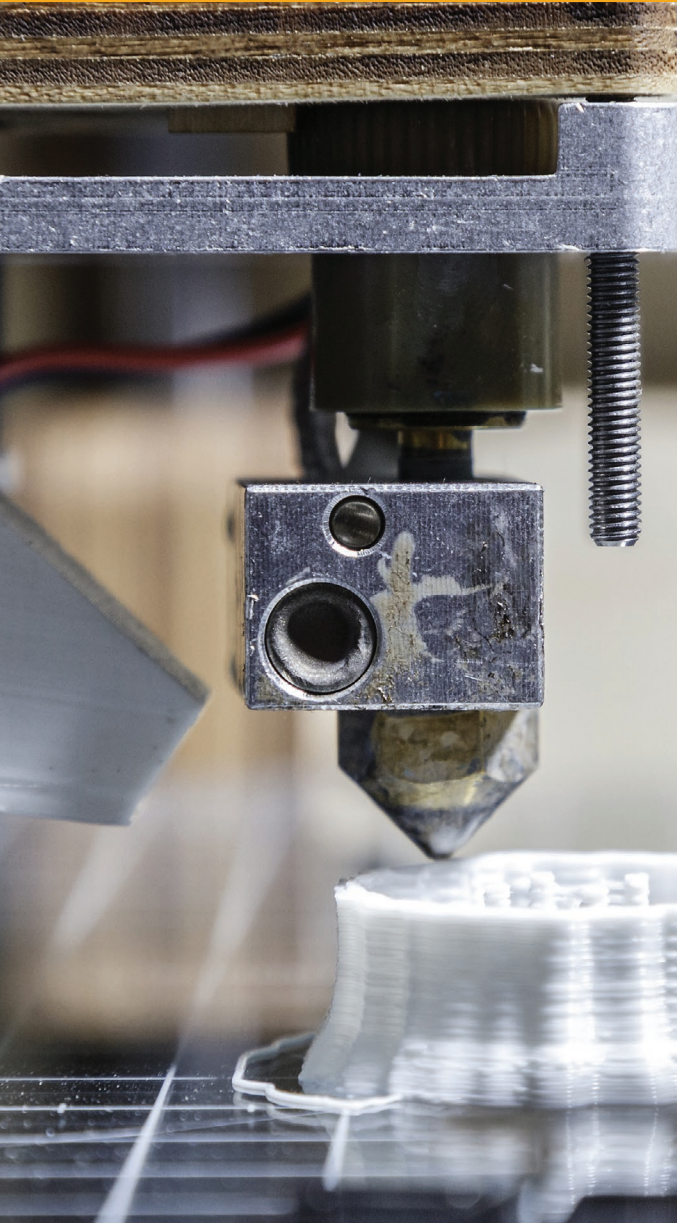


3D PRINTING—A FAST MOVING MARKET



Developments in 3D Printing

A Sector by Sector Overview

Overview

This report explores recent developments across a number of sectors as it relates to 3D printing and its impact on each sector. We've limited our scan to the last three months to demonstrate the pace and scope of activity in the market.



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General

SAP and Stratasys Partner for 3D Venture

German enterprise software company SAP inked a partnership with 3D-printing pioneer Stratasys to build a “global network of 3D printing co-innovation labs to educate and enable customers, employees and partners on the adoption of additive manufacturing as an integral part of the manufacturing production line.” The digital manufacturing and co-innovation sites are currently being deployed across Paris; Johannesburg, South Africa; Walldorf, Germany; Newtown Square, Pa., and Palo Alto, Calif. The companies say the alliance will help them move forward with a common vision to bring value to customers’ supply chains.

3D Printing Opens Millions of Stop-Motion Possibilities

To create the critically-acclaimed stop-motion picture *Kubo and the Two Strings*, Laika Studios sought the assistance of Stratasys’ Connex3 color multi-material 3D printer to create thousands of different expressions for each of the characters’ faces. The figure of Kubo used for the film is only 9 inches tall yet has 11,007 unique mouth positions, 4,429 brow motions and a total of 23,187 different faces. Film makers on a budget are turning to 3D printing because of the creative possibilities it offers but also because it can help lower production costs.

Auburn University in Alabama Plans Global 3D Printing Hub

Auburn University is establishing a new Center of Industrialized Additive Manufacturing (CIAM). The university will further the links to 3D printing in Alabama with General Electric, which already operates a facility in Auburn. The University has been given a three-year \$1.5-million grant from the National Institute of Standards and Technology (NIST). Tony Overfelt, the William and Elizabeth Reed Professor of Mechanical Engineering at Auburn University, was selected as its inaugural director. Overfelt sees an opportunity to make Alabama a leader in additive manufacturing and spur workforce development by immersing students in this new technology.



Cybersecurity & 3D Printing

Researchers Hack and Crash a 3D Printed Drone

Researchers from the University of South Alabama and Singapore University of Technology and Design, in a paper entitled “[dr0wned: Cyber-Physical Attack with Additive Manufacturing](#),” were able to sabotage a drone by hacking the computer controlling the 3D printer that made its parts. Using a phishing attack, the researchers gained access to the PC that was connected to the 3D printer. After finding the design files for the propeller of the drone, they replaced the file with an altered version that, once printed and installed, performed incorrectly and caused a crash. The goal of the research was to illustrate “how a cyber attack and malicious manipulation of blueprints can fatally damage production of a device or machine,” the authors said.

Cubichain Technologies Uses Blockchain Tech to Improve Cybersecurity in 3D Printing

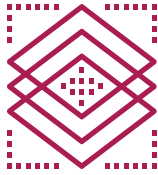
Cubichain Technologies and CalRAM successfully demonstrated the deployment of a blockchain network to protect the digital data stream for additively manufactured aerospace titanium parts. Using the MultiChain private blockchain platform, based on Bitcoin Core, Cubichain Technologies is developing an application that interfaces with the 3D printing industry processes. The blockchain is used to encrypt critical digital data associated with the binary part definition and then store that information on an internationally distributed private blockchain. It is anticipated that addressing the \$1.7 trillion/year product counterfeiting market will lead the way for cross-industry adoption of the Cubichain solution and the novel blockchain approach. The ultimate deployment for the blockchain is when there is an immutable identification embedded in the part that cannot be altered and it is preserved in an equally immutable ledger.



Patents and Copyright Disputes

Cheerleader Uniform’s Supreme Court Battle has Implications for 3D Printing Industry

Varsity Brands and Star Athletic continue to battle it out over whether the colorful stripes and chevrons on a cheerleading uniform can be protected, this time making their arguments heard in U.S. Supreme Court. The case has significant implications for the fashion industry and has drawn attention from a number of “free-Internet” organizations and makers who create their own clothes (including via 3D printing). [Public Knowledge](#), a non-profit that advocates against IP laws that inhibit the free flow of information, filed an amicus brief opposing Varsity Brands. Public Knowledge posits that with copyright protection lasting 100 years or more, it’s essential to prevent monopolies in useful objects.



Materials

MIT Develops 3D Printed Shock Absorbing Skins to Better Protect Expensive Robots

Researchers at MIT are making robots more resistant to damage with 3D printed shock-absorbing skins they call programmable viscoelastic material (PVM). By varying the stiffness of material as it's made, scientists can create a bumper that absorbs energy in more efficient ways. The printer allows a material to be created with multiple materials, each with different mechanical properties. The team was able to use a standard printer to deposit a solid, liquid, and flexible rubber-like material called TangoBlack in their designs. The researchers envision PVM materials as coverings for flying delivery drones, robotic warehouse workers, and more. Custom programmable viscoelastic materials could also be created for helmets to more effectively protect the head, or running shoes that transfer less energy into the wearer's feet.

MIT Software Strives to be the Photoshop of 3D Materials

The new software developed by MIT's Computer Science and Artificial Intelligence Lab, called Foundry, aims to become the "Photoshop for 3D materials" by helping print in high resolution using multiple, functional materials at once, giving designers and operators a way to print complicated objects that combine different materials in a wide variety of possible ways to give different parts of the object different properties. Using the new MIT software, researchers printed a ping-pong paddle, skis with very shiny surfaces, the wheel for a tricycle, a bike helmet and a bone, which the team says could actually be used in surgical planning applications.

Graphene 3D Lab Files Patent for Graphene-enabled G6-Impact™ Composite

Graphene 3D Lab has successfully developed a graphene composite material intended for users in the automotive, robotics, drone, aerospace industries and military sectors. This material will be marketed under the trade name of "G6-Impact™." The company has filed a provisional patent application covering methods of production and formulation as well as the potential applications of the G6-Impact™ material. G6-Impact™ will be an optimal material for applications where vibration damping is required on rigid surfaces, which could include sporting gear, power tools handles, automotive parts, and aerospace components. The composite material is developed based on a combination of High Impact Polystyrene (HIPS) resin, Carbon Fibers and Graphene Nanoplatelets.

XJet Showcases 3D Ceramic Capabilities

At the [formnext 2016 expo](#) held in Frankfurt, XJet [unveiled](#) its NanoParticle Jetting technology for ceramic 3D printing. The technology relies on an ultra-thin layer of droplets that contain ceramic nanoparticles. The droplets are put into the tray which then produces ceramic parts with the versatility of inkjet printing. Ceramics are [widely used](#) in the dental industry, while patients do opt for metal crowns with gold and silver being an option, most patients seek ceramic solutions as they provide a more convincing look and blend in with other teeth. The potential advantages of 3D printed ceramic crowns are primarily ease of use and speed. If XJet and other 3D printing companies continue to refine their technology it could eliminate the need to send dental work away to laboratories and technicians.

UCSD Engineers Unveil Self-Healing Ink for 3D Printed Batteries, Circuits and Sensors

Engineers from the University of California San Diego (UCSD) have successfully developed a 3D printable magnetic ink that can be used to create self-healing batteries, electromechanical sensors, wearable, textile-based electrical circuits, and more. The ink automatically repairs itself within only fractions of a second. To make the ink, the engineers used micro-particles of neodymium, each of which possesses a magnetic field larger than its size. The micro-particles are arranged in a precise orientation determined by a magnetic field, which allows them to join back together even when they are torn apart.

Spidey Tek's Spider Silk Material has Potential for 3D Printing

Los Angeles-based biotech company Spidey Tek plans to produce real spider silk material for a variety of production purposes. The company's patented spider silk production process is founded on genetic code that is cloned into specialized microorganisms and placed in a bio-reactor. This process harvests real spider silk proteins, which can then be mixed with various chemicals and can also be used to create real spider silk fibers. The biotech company is confident that their silk can be utilized to replace other widely used materials, including carbon fiber, steel, and aluminum. Spidey Tek claims that their product exhibits a tensile strength of 40,000 MPa, which is 10 times that of natural spider silk and 100 times that of carbon fiber.



Military and Government

U.S. Marines Trial Invent3D Printer

The U.S. Marines have started testing additive manufacturing in the field and it could pave the way for the military to carry 3D printers as a matter of course. The Marines and other military units are often deployed in remote regions and there is a limit to how much equipment they can take along for the ride. A 3D printer, though, could allow them to print thousands of basic parts, from water bottles to spares for a rifle or truck and even simple tools. The military is starting simple, with an Invent3D printer with a single extrusion head and a maximum temperature of 220 degrees Celsius. That means the team is limited to creating plastic parts, for now. The Marines have already started a series of 3D printer training integration exercises in Arizona and is determined to train every squadron how to use the printers in the field.

Government of India Developing National Policy for Advanced Manufacturing

The government of India is formulating a National Policy for Advanced Manufacturing as one of the key tools to attain its objective of increasing the contribution of manufacturing output to 25% of GDP by 2025. The national policy for advanced manufacturing would include advanced materials, modern manufacturing like advanced robotics and 3D printing, among others. The National Policy for Advanced Manufacturing also aims to significantly enhance India's global manufacturing competitiveness.

Government of South Korea Identifies 3D Printing as Next Gen Growth Driver

The government of South Korea unveiled a list of emerging technology sectors, including 3D printing, that it wants to develop as its next-generation drivers of growth. The government plans to help car and aviation industries swiftly adopt the 3D printing technology. Also, the government will encourage the military and railroad sectors to produce components through the 3D printing technology. Medical sectors will be encouraged to produce artificial bones or rehabilitation devices using 3D printers, according to the plan.

European Defense Agency Examines Military Applications for 3D Printing

The European Defense Agency (EDA) launched a new project to examine military applications for 3D printing. According to the agency, the project aims to identify areas where additive manufacturing can be effective in enhancing defense capabilities. To support the effort, the EDA has contracted the Prorintec Foundation and French arms manufacturer MBDA.



Mergers and Acquisitions

GE Scoops Up Germany's Concept Laser, Takes a Stake in Sweden's Arcam

General Electric agreed to buy privately held German 3D printing firm Concept Laser for \$599 million, after its bid for rival SLM Solutions failed. GE abandoned its bid for SLM after activist investor Elliott Advisors, which owns 20% of SLM, rejected its bid, making it harder for GE to reach its minimum acceptance threshold. Concept Laser's customer base is focused on the aerospace, medical and dental industries, and it also has a presence in the automotive and jewelry sectors. GE did, however, raise its bid and lower its minimum acceptance condition for Swedish 3D printer maker Arcam, in which Elliott Advisors also owns a stake. It was later confirmed in mid-November that GE had purchased controlling shares of Arcam.

3D Hubs Buys Printivate to Improve 3D File Handling, Printability Prediction

The Netherlands-based 3D Hubs, which operates an online marketplace for 3D printing services, acquired Printivate, a service dedicated to the optimization and repair of 3D models. Printivate will be integrated into the 3D Hubs platform to improve 3D file handling and printability prediction. With the acquisition, 3D Hubs hopes to streamline the incoming order flow, reduce handling and turnaround time per print, allowing them to take more orders at less cost. As a result, it expects potential failure rates to drop and print quality to improve.

Global Tech Group Oerlikon Builds on 3D Printing Capabilities with Acquisition of citim

Swiss global technology group Oerlikon has acquired German company, citim, an additive manufacturing design and production of metal components company. The acquisition expands Oerlikon's 3D printing technology and service portfolio. The acquisition of citim will help it establish 3D printing capabilities in Europe and in the U.S. citim's core expertise mainly lies in metal additive manufacturing for small-series production and functional prototypes. Operating production sites in Europe and the U.S., citim currently contributes to high-tech industries like aviation, automotive and energy.



Money and Investment

Cincinnati's Polar3D Secures \$2 Million, Gears Up for Series A Round in 2017

Cincinnati-based Polar3D raised \$2 million of angel funding from private investors. The company intends to use the funds to expand its operations and the capabilities of its cloud platform. Additional investment in the company is set at \$6.5 million for a planned Series A round in 2017 and will follow the release of Polar Cloud 2.0 in January 2017.

New York-based BotFactory Raises \$1M in Seed Funding

New York City-based BotFactory completed a \$1-million seed round of financing led by New York Angels. The funding is largely being allocated for expanding sales and marketing efforts as well as product development. BotFactory is mostly known for their Squink PCB 3D printer, a \$3,000 desktop Wi-Fi connected PCB 3D printer. The Squink is an all-in-one desktop PCB factory that can print traces on Kapton and FR4, as well as many novel materials like ceramics and metals.

\$16 Billion Hedge Fund Soroban Capital Partners Doubles Down on Autodesk

Soroban Capital Partners, a New York hedge fund with over \$16 billion in assets, is betting heavily on the success of 3D printing software manufacturer, Autodesk (NASDAQ: ADSK). According to documents filed with the Securities and Exchange Commission, the hedge fund increased its stake in Autodesk to become one of the largest investors in the California-based software company, owning 8% of the company.

3D Bioprinting Company EpiBone Secures Investment from Series of Investors

EpiBone, a biomedical tech startup that uses 3D bioprinting to grow human bones, received a \$560,000 investment from Plum Valley Investment, a private membership started to support female entrepreneurs and gender-diverse teams. The investment was made alongside other funders, including the Partnership Fund for NYC, Breakout Labs, and other angel and institutional investors, which altogether brought in a multi-million dollar capital raise for EpiBone. The company's co-founder and CEO, Dr. Nina Tandon, aims to enhance the traditional techniques of reconstructive bone surgery by generating bones from patient-specific stem cells, which she hopes will reduce the need for multiple surgeries and improve the overall outcome for the patient.

Dubai Future Foundation, Autodesk Launch \$100M 3D Printing Investment Fund

Dubai Future Foundation has partnered with U.S. software firm Autodesk to set up a \$100-million investment fund that will provide financing for entrepreneurs and startups in the 3D printing space in the Gulf region. The investment will focus on businesses relying on 3D printing in their operations by developing the technology, increasing innovation in the sector and incubating 3D printing startups in the region. The agreement aims to accelerate the establishment of a regional 3D printing market, which will see the creation of products catering to sectors such as manufacturing, construction and medical and consumer goods. The initiative aims to Dubai and the UAE an international hub for the sector and to drive growth in the global 3D printing market, expected to be worth \$300 billion by 2030.

GE Subsidizes 3D Printers for Education Programs with \$10M Investment

GE Additive, the branch of GE dedicated to additive manufacturing technologies, will invest \$10 million over the course of the next five years into two educational programs geared towards developing 3D printing technologies and training future talent within the field. Of that amount, \$8 million will go towards subsidizing a total of at least 50 metal 3D printers for universities and educational institutions around the globe. The other \$2 million will be allocated for primary and secondary schools around the world, and will be used to subsidize up to 2,000 desktop 3D printers for a number of selected institutions.

Robo 3D Debuts on the Australian Stock Exchange

California-based consumer 3D printing company Robo 3D opened at \$0.11 per share on the Australian Securities Exchange. The startup completed an oversubscribed \$6 million capital raising through a reverse takeover. Founded in 2012 by a group of San Diego State University students who built their own 3D printer after having trouble finding an affordable one, Robo 3D delivered its first consumer printer model in 2013. Co-founder Braydon Moreno said the company is building a whole 3D ecosystem – from printers to the 3D-printable content and the materials.

Canadian Government Agency Invests \$7.3M in New SONAMI Advanced Manufacturing Network

The Canadian federal government announced a non-repayable contribution of up to \$7.3 million to support a new advanced manufacturing network that aims to help small- and medium-sized manufacturers adopt new technology. The investment will help Niagara College create the Southern Ontario Network for Advanced Manufacturing and Innovation (SONAMI) in partnership with Mohawk College, Sheridan College and McMaster University. SONAMI will offer a “single-window” approach to support manufacturers’ research and development needs and encourage them to adopt and integrate disruptive advanced manufacturing technologies into their operations with the help of the network. The project is expected to create or maintain 186 jobs, result in 170 new prototypes and up to 85 new products being commercialized, as well as provide opportunities for students from the SONAMI partner institutions.



Transportation and Logistics

3YOURMIND, DPD Team to Simplify Supply Chains

3D printing service portal 3YOURMIND has partnered with Dynamic Parcel Distribution (DPD) to simplify the overall supply chain. As more businesses and individuals now own 3D printers, the transfer of goods is beginning to take place more in the digital space and less in the physical, meaning logistics companies need to alter the way they do business. DPD will leverage their wide-ranging delivery services to help 3YOURMIND meet the needs of customers, but both companies share a vision of 3D printing as a mobile service as well. The collaboration will mean a network of mobile additive manufacturing centers with the capability to service numerous industries, that can even be rented by manufacturing companies to boost their production flow in peak production times.

UPS, SAP, Fast Radius Launch Effort to Better Companies' Access to Large-Scale 3D Printing, Virtual Warehousing

UPS, along with partners SAP and Fast Radius, a Georgia-based manufacturer, have launched an effort to bring 3D printing into the world of scaled industrial production. The partners have teamed up to print everything from auto parts to medical devices. All of this is done at scale with production runs numbering in the hundreds of units. It's available as an "on-demand" service at UPS facilities — allowing 3D printing customers to take advantage of the global shipping giant's logistical services. UPS and Fast Radius have an on-demand 3D printing factory in Louisville, Kentucky and expect to open a 3D printing factory near the UPS facility in Singapore.

DHL Explores 3D Printing's Opportunities, Limitations for Logistics Industry in New Report

In its latest trend report, [*3D Printing and the Future of Supply Chains*](#), DHL notes that 3D printing is unlikely to completely render the factory manufacturing model obsolete, but that the technology would certainly come to complement mass production by simplifying the production of complex and customizable parts. DHL VP of Innovation and Trend Research, Markus Kückelhaus, said there was increased market interest in 3D printing, with various companies being encouraged by its potential for greater customization, less waste and more localized manufacturing and delivery. He believes 3D printing will have the most impact in the medium term on logistics, in spare parts and individualized parts manufacturing. But not all products should, can or will be 3D-printed, he added.



Healthcare

Northwestern University Researchers Create Customized, Biodegradable 3D Printed Stents

Researchers at Northwestern University turned to 3D printing to create vascular stents of any size, allowing each stent to be perfectly customized to a patient's unique anatomy. They tweaked a technique called projection micro-stereolithography (PμSL), which works by projecting light onto a liquid photo-curable material that quickly solidifies. The new technique is called micro-continuous liquid interface production (microCLIP) and can be used to print objects with a resolution down to 7 microns. The researchers used a citric-acid based polymer as the building material, which is flexible, biodegradable, and works as an antioxidant. The same polymer can also host drugs, such as rapamycin, that would be released as the stent slowly biodegrades to prevent restenosis.

South Korean Researchers Develop 3D Bio-Printed Spider, Moth Silk to Fix Bone Fractures

Seoul South Korea's Rural Development Administration (RDA) and Hallym University have created a 3D Silk-Printing System that produces components suitable for use in vivo (i.e. within a living organism). The silk 'filament' is made from the fibroin protein, which is also present in silk produced by spiders and larvae of members of the moth family. The fibroin will be used to recreate the plates and screws used to fix broken bones. Once the technology becomes commercialized, it could enable the production of a greater variety of bio-compatible silk medical equipment.

Harvard Researchers Develop First 3D-Printed Organ-on-a-Chip with Integrated Sensors

Harvard University researchers have developed the first entirely 3D-printed organ-on-a-chip with integrated sensing. Built by a fully automated, digital manufacturing procedure, the 3D-printed heart-on-a-chip can be quickly fabricated and customized, allowing researchers to simplify data acquisition for short- and long-term studies. The researchers developed six different inks that integrated soft strain sensors within the microarchitecture of the tissue. In a single, continuous procedure, the team 3D-printed those materials into a cardiac microphysiological device with integrated sensors. The chip contains multiple wells, each with separate tissues and integrated sensors, allowing researchers to study many engineered cardiac tissues at once.

Miami Children's Hospital Turns to 3D Printing to Save Young Girl's Life

Surgeons at Miami Children's Hospital have saved a young girl's life using a 3D-printed heart model which helped them visualize a complex procedure. The four-year-old girl was born with total anomalous pulmonary venous connection (TAPVC), a congenital heart disease. Doctors used Materialise's Mimics Care Suite to print a 3D replica of her heart based on her CT scans. surgery. As Dr. Redmond P. Burke explained: "This was printed out because she was thought to be inoperable and by having this type of model we were able to conceive of an operation that hadn't been done before, connecting the small veins from her lungs up to her heart."

3D Systems Previews New Solution for Converting Medical DICOM Data to Digital 3D Models

3D Systems previewed its D2P (DICOM-to-Print) software solution for rapidly converting patient specific medical data into digital 3D models. A planned enhancement to the company's end-to-end healthcare workflow, D2P is designed to make it easier for doctors to practice and plan complex surgical procedures using digital 3D anatomical models and to facilitate the printing of physical 3D anatomical models. According to 3D Systems, D2P software will deliver patient specific digital models to be exported for various uses. Such applications include CAD software, virtual reality visualizations and 3D printing.

Mount Sinai Launches 3D Printing Service for Clinicians, Researchers

New York's Mount Sinai Health System created the Medical Modeling Core, a collaboration led by its Department of Neurosurgery, where clinicians can confer and order 3D models for their cases. Virtual reality, simulation and 3D printing services will be provided on a low-cost fee-for-service basis. Four 3D printers will be brought in as well as a laser cutter to allow for the fabrication of neuroanatomy models specific to each patient and their individual medical case. The team handling 3D printing services is led by Dr. Anthony Costa, Assistant Professor for the Department of Neurosurgery and Scientific Director of the Neurosurgery Simulation Core at the Icahn School of Medicine at Mount Sinai. Dr. Costa has developed segmentation tools and computer code to speed up the process of turning radiological data into models appropriate for 3D printing and modeling. Recent prints include skull-base tumors with surrounding vasculature and cranial nerves, spine modeling for the correction of severe scoliosis, and pelvic models for the planning of arthroplasty.

New Ultrasound Device Uses 3D Printing Technology

Scientists from Nanyang Technological University, Singapore have developed an ultrasound device that produces sharper images through 3D- printed resin lenses. In current ultrasound machines, the lens which focuses the ultrasound waves are limited to cylindrical or spherical shapes, restricting the clarity of the imaging. The 3D- printed lenses allow ultrasound waves to be focussed at multiple sites or shape the focus specially to a target, enabling surgeons to conduct more accurate medical procedures that involve the use of ultrasound to kill tumours, loosen blood clots and deliver drugs into targeted cells. With this breakthrough, the NTU team is now in talks with various industry and healthcare partners that are looking at developing prototypes for medical and research applications.

German Researchers Use 3D Printed Kidney Models to Determine Optimal Radiation Dosage

Researchers at the University of Würzburg in Germany have been using 3D printing to prototype kidney models, or kidney phantoms, of different shapes and sizes to assess how much radiation is needed for optimal imaging. The kidney phantoms, with liquid volume capacities ranging from 8 mL (newborn) to 123 mL (adult) were 3D- printed with a Renkforce RF1000 FDM printer in ExcelFil PLA filament. The 3D- printed phantoms were then used to test the accuracy of quantitative imaging for internal renal dosimetry.

Georgia Tech Researchers Leverage 3D Printing to Improve Valve Replacement Procedures

Researchers at the Georgia Tech Manufacturing Institute are working on a tool that could help cardiologists care for patients diagnosed with heart valve disease. Using highly detailed imaging from CT scans, mechanical engineers are using 3D printers to make an exact model of an individual patient's heart valve. The aim is to provide physicians with a tool for planning procedures to treat aortic stenosis, a condition commonly associated with elderly patients and believed to be increasing in prevalence as the population ages. The 3D printed heart valve models are particularly useful in planning a procedure called transcatheter aortic valve replacement, during which heart doctors use a catheter to deliver a prosthetic heart valve to replace the patient's impaired valve. The most important factor for a positive outcome is matching the patient's natural heart valve with a prosthetic of the right type and size – an area ripe for 3D printing. Using a machine capable of multimaterial 3D printing, researchers are able to adjust the design parameters of the metamaterial used for printing, allowing them to closely mimic physiological properties of the tissue to create heart valve models.

3D Printing's Impact on Prosthetics, Medical Devices

Medical science is seeing a significant boost from 3D printing. New startups in the 3D manufacturing realm are creating better prosthetics and customizable medical devices that are more advanced than previous models. For instance, two startups – Bioniks and Voodoo Manufacturing – are creating unique prosthetics for patients. Bioniks, a bio-medical printing startup based in Pakistan, has created a total of 25 bionic arms. Bioniks claims it's the first company of its kind in Pakistan and expects to be able to tap into the extensive disabled market, catering first for those missing arms before extending into other areas such as dental, leg and finger prosthetics. The company currently relies on outside sources of funding, such as crowd campaigns, but is working on ways to cut costs to eventually be self-sustaining. Meanwhile, Voodoo Manufacturing claims to be the largest manufacturer of 3D printed hands in the world – having made more than 1,250 of them to be sold across the world. In addition, the startup has 3D printed the components needed for ECG headsets that can measure brain waves and are capable of measuring brain, muscle and heart activity – offering a variety of medical applications.

FDA Works with Academics, Industry, Set to Roll Out More Guidance on 3D Printing

With manufacturers using 3D printing to create devices matched to a patient's anatomy and devices with complex internal structures, the FDA has started working with universities, researchers and industry to further understand these products and issue more guidance. James Coburn, senior research engineer with the FDA, said that while we're a long way off from having a 3D printed kidney or heart, the agency is still looking into the technology to protect the safety of patients. In early 2016, the FDA approved the first 3D printed drug, Aprexia's epilepsy drug Spritam (levetiracetam). For biologics, researchers are considering 3D printing as a way to better manufacture cell and tissue products. The FDA has also cleared more than 85 3D-printed devices, most of them via the 510(k) or emergency use pathways.



Manufacturing and Construction

Dubai's Roads and Transportation Authority Uses 3D Printing to Maintain Metro Stations

Dubai's Roads and Transport Authority (RTA) is using 3D printing to upgrade select systems across Dubai Metro stations, including parts for subsystems of ticket vending machines, ticket gates and other areas of metro trains. RTA CEO AbdulMohsin Ibrahim Younes said that 3D printing technology would enable the RTA to keep Dubai Metro assets in service longer while reducing the cost of parts and, in turn, passing savings back to customers.

Sunconomy, Apis-Cor Partner to Create First 3D Printed Houses in U.S.

Home builder Sunconomy is partnering with Russia-based 3D printing company Apis-Cor to create the first 3D printed houses in the U.S. The two homes will be donated to the Non-Commissioned Officers Association to be occupied by a war veteran and the Restore Texas Ministries, which helps former prison inmates transition back to normal life. Apis-Cor's 3D printer can build an entire multi-story home in a single day by printing layer after layer of appropriate material. The method is said to limit waste, reduce labor costs and consume less energy. With the use of 3D printing, Sunconomy hopes to build affordable housing for veterans and others.

'Swiss MIT' Researchers Win Innovation Prize for New 3D Printing Technique in Construction

Researchers with Zurich-based group Gramazio Kohler Research created a new technique for concrete construction using robotics and metal mesh. Using a robot arm to mold metal into a grid-like mesh, the Swiss team hopes to provide a successful alternative to traditional construction processes. With the use of metal mesh mould, the group aims to eradicate the need for external formwork while still providing concrete reinforcement. The technique could enable complex structures to be built out of concrete without the need to create made-to-measure formwork, or complex metal reinforcement rods. The group won the Swiss Technology Award 2016 for this venture into metal mesh.

Hong Kong's Jiayuan Teams with 3D Printing Company to Customize Outdoor Landscapes, Products

Property developer Jiayuan International Group is making a push into 3D-printing construction through a strategic partnership with WinSun Decoration Design Engineering, a Chinese company known for its technology that can 3D-print entire buildings. Jiayuan International would work with WinSun to apply 3D printing technology for landscape gardening and outdoor products in its upcoming property projects. Once China's 3D-printing construction standards have been finalized, Jiayuan International would explore the possibilities of using the technology to construct buildings, as it believes the technology could reduce building costs by about 10% to 50%.

Spain Unveils World's First 3D Printed Pedestrian Bridge

The City of Alcobendas in Spain unveiled the first ever 3D printed pedestrian bridge made entirely of concrete. The landmark structure represents a milestone in civil engineering, an industry that has been reluctant to use additive manufacturing. Made up of eight separate pieces that fit together, the architectural design of the walkway was implemented by the Institute of Advanced Architecture of Catalonia, and later constructed by Acciona, a Spanish civil engineering company. As a result of the practice of recycling raw materials during the manufacturing process, as well as the overall sustainability of 3D printing, the bridge incurred virtually no economic cost to the city. The municipality reports that the amount of waste, resources and energy typically needed to realize concrete structures was vastly reduced.

Myanmar Farmers Reap Rewards from 3D Printed Tools

3D printing is being used to develop tools for impoverished farmers in Myanmar. The country's manufacturing sector was gutted under five decades of isolationist military rule, forcing farmers to cobble together their own tools or use ill-adapted imports. Social enterprise Proximity Design is turning to 3D printing to design specially adapted tools, in consultation with the farmers who use them. Once the design has been perfected, it is sent to factories in other countries where the part is mass produced. One farmer said the 3D printer-designed sprinkling system he installed on his half-acre parcel of land has helped him cut by half the amount of time he must put in each day to water his plants.

**Wearables****DSW Unveils 3D Printed Shoe Option at Pop-Up Shops**

Columbus-based footwear and accessories retailer DSW launched a pop-up shop in two stores featuring custom 3D printed shoes. The Feetz@DSW pop-up shops use proprietary technology created by Feetz, the first company to use 3D printing technology to make custom fit shoes. The company uses a mobile scanner to capture 5,000 datapoints and 22 dimensions to produce a customized 3D printed shoe in less than two weeks. The 3D printer uses flexible fibers made up of rubber and synthetic material that can be recycled.

Reebok Creates 'Liquid Speed' Shoe Using Proprietary 3D Drawing Technology

Athletic footwear and apparel company Reebok turned to 3D printing technology for its latest creation, the Liquid Speed shoe. The 3D printed winged frame of the Liquid Speed shoe wraps up and around the base of the shoe, creating a tighter fit for the wearer. Reebok uses a unique proprietary 3D printing process to create the shoes, which was developed in collaboration with BASF and the Michigan-based reactive resin producer RAMPF Group. The production process creates a futuristic aesthetic and a performance-enhancing experience for the wearer, while the proprietary technology allows Reebok to customize the design in a quick and efficient manner.

Canada's Wiivv Wearables Continues to Make Waves in Custom 3D-Printed Apparel Market

Wiivv Wearables, a Canadian bionics startup that 3D prints custom gear, especially insoles for footwear, is among the first companies to let consumers use their smartphone to take a 3D scan of their feet. By doing so, the company's goal is to print the perfect insole to maximize comfort, reduce pain and promote healthy alignment. Wiivv's app guides the user through the whole process, which takes just a few minutes. From there, the user can customize its insole with different colors and designs. The resulting insole is made of Nylon 12 (the same material used for traditional custom insoles), and it can be slipped easily into running shoes, dress shoes, or casual shoes. Wiivv eventually wants to create body-perfect gear ranging from apparel to orthopedics, but existing technology-made insoles is the best place to start.

Print to Order, A New Era for Fashion

Well known futurist and a director of engineering at Google, Ray Kurzweil believes people will be 3D printing tailored clothing in their home by 2020. "As the variety of materials available to print in 3D become more extensive and less expensive, both free open-source and proprietary clothing designs will be widely available online in as little as 10 years," Kurzweil said. He believes brands will still give customers designer offerings and new trends, but that the manufacturing process will be transformed and consumer appetite will boom as the world gets wealthier and standards of living rise. "By 2020 there will be a whole host of products available immediately to buy for pennies on the dollar and to print straight away," he said. "It will become the norm for people to have printers in their homes," he continued, adding that food and housing materials will also be printable.



Auto Industry

Honda Continues Efforts in 3D Printed Cars

Honda, in partnership with additive manufacturing specialist Kabuku, built a custom delivery electric vehicle for a confectionery business using 3D printing technology. The two companies took a small electric chassis and designed a custom panel van body around it, perfect for delivery of small parcels around town. The EV chassis and drivetrain were almost the only parts of the van that were not 3D-printed; most body panels were designed from scratch to fit existing hardware, such as headlights. The automaker [unveiled](#) the single-seater electric car at CEATEC 2016, a Japanese consumer electronics show.

Divergent 3D Continues to Make Waves in Auto Industry with 3D Printed Parts

Divergent 3D, a 3D printing auto manufacturing company, recently signed a partnership with PSA Group (Peugeot and Citroën), as well as with engineering firm Altran. Divergent 3D's goal is to allow OEMs to manufacture automobile components at a fraction of the cost by using less energy than conventional manufacturing methods. The company's technology uses direct-metal laser sintering. Layers of aluminum alloy powder are built up to create

the necessary parts or to build molds for non-metallic components. Because complex shapes can be created easily, parts previously made of several pieces that had to be welded together can now be created as single pieces. Divergent 3D and its partners are currently working to cut the number of parts per vehicle by 75% and reduce the weight of a vehicle's "body-in-white" by half, making it lighter and more fuel efficient.

Makers of 3D-printed 'Super Car' Unveil their 'Super Bike'

At the Los Angeles Auto Show held Nov. 18-27, Divergent 3D showcased its new "super bike" design, the Dagger, which sits on a 3D-printed chassis. The printing process produces a carbon fiber structure that Divergent 3D claims is 50% lighter (while being stronger too) than traditional motorcycle materials, making the frame more efficient on the road. Because of the opportunities provided by 3D printing, Divergent 3D CEO Kevin Czinger envisions a supply chain that could become more easily accessible for smaller companies, creating a much more diverse automotive landscape in the future.



Energy

Report Explores 3D Printing's Impact on Oil & Gas Climate Gains

According to a Lux Research report, *Assessing the Opportunity of Additive Manufacturing for the Oil and Gas Industry*, oil majors including Halliburton, Schlumberger and Shell are turning to 3D printing to improve efficiencies and profits in this era of low oil prices. Oil and gas companies should engage with metal printing companies such as EnergyX and Arevo to develop new printing techniques for use cases like liner hanger spikes. For drill bits, candidate partners include Nanosteel and QuesTek Innovations, the report notes. However, it warns that 3D printers are more energy intensive than conventional equipment, which means the manufacturer consumes more power – and generates more emissions. As other industries using 3D printing have found, the environmental gains come from reduced waste volumes compared to conventional manufacturing.



Aviation

Airbus Standardizes Stratasys' 3D Printing Material for A350 XWB Aircraft Supply Chain

Airbus officially standardized on Stratasys' ULTEM 9085 3D-printing material for the production of flight parts for its A350 XWB aircraft. The resin is certified to an Airbus material specification and is used in Stratasys' fused deposition modeling additive manufacturing equipment. By combining a high strength-to-weight ratio with flame, smoke and toxicity compliance for aircraft flight parts, Ultem 9085 enables the production of strong, lighter-weight parts while lowering manufacturing costs and production time, Stratasys said.

Arconic, Airbus Strengthen 3D Printing Partnership

Arconic, a global technology and advanced manufacturing company, entered into two agreements to supply Airbus 3D printed metal parts for the airplane maker's commercial aircraft. Arconic will supply 3D printed ducting components made of high-temperature nickel superalloys for the A320 family of aircraft. Advanced nickel superalloys offer superior heat resistance for these components, which flow hot air from the aero engine to other parts of the airframe. Under a separate agreement, Arconic will supply 3D printed titanium airframe brackets, also for the A320 platform. Arconic expects to deliver the first parts under both agreements in the second quarter of 2017.

Airbus Selects Sciaky's EBAM Metal 3D Printing System to Develop Large Titanium Structural Parts

Sciaky, a subsidiary of Phillips Service Industries, has been selected to provide its electron beam additive manufacturing (EBAM) 110 System to Airbus. Once delivered, Airbus will use the industrial-scale metal 3D printing to produce large titanium-made structural parts. The EBAM process combines computer-aided design, additive manufacturing processing principles and an electron beam heat source that helps produce 3D printed parts.

**Food****Finland Researchers Unveil 3D Printed CellPod, a Device that Grows, Produces Food at Home**

Scientists from VTT Technical Research Centre of Finland created the first-ever 3D-printed CellPod prototype that could grow and produce food. The device acts like a plant incubator that looks like a design lamp. Rather than growing a whole plant, the CellPod only grows undifferentiated cells of the plant. These cells contain the plant's entire genetic potential, so they are capable of producing the same healthy compounds – such as antioxidants and vitamins – as the whole plant. So far, VTT has used cells from its own culture collection to grow Arctic bramble cells, cloudberry cells and stone bramble cells in the CellPod. The bioreactor also enables the production of healthy food from plants other than traditional food crops, such as birch.

3D Printed Meat Products Could Offer Solution for People with Chewing, Swallowing Problems

Meat and Livestock Australia (MLA) claims that meat could be used in 3D printing to produce a soft food with specific nutrients suitable for people who have problems with chewing or swallowing. By using a meat extract as ink, layer-by-layer, a food could be created that is as soft as butter, while still being packed with nutrients. MLA was alerted to the possibility of red meat three-dimensional printing after it found Germany had 3D printed food in 1,000 nursing homes. Dr. Aarti Tobin, Meat Science Team Leader at Australia's Commonwealth Scientific and Industrial Research Organisation, said the combination of gels and starches with meat ink could produce something more appetizing than what some senior care homes are serving now.
