What's the State of Engineering in 3D Printing?

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Simply put, 3D printing is poised to radically change the world you live in. While the technology has been around since the 80s, only in the last few years, with technology advances and dropping prices, has it caught the attention of most people. Today, 3D printing is rapidly evolving with new players entering the field, more patents expiring, new technologies (e.g., CLIP and Multi-Jet Fusion) being developed, and supporting software catching up. It's estimated that the market will grow to $20 billion by 2025.

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Disruptive Technology Doesn't Have to be Disruptive

Over 30 years ago, two major companies invented the major technological components of 3D printing, and they're still the dominant technologies currently in the market. In terms of 3D printing of object, three processes have become popular.

The first is called fused deposition modeling (FDM). It uses a thermoplastic filament, which is heated to its melting point and then extruded, layer by layer, to create a three-dimensional object. This rather slow process supports acrylonitrile butadiene styrene (ABS) and polylactic acid (PLA) types of materials.

The second process is called selective laser sintering (SLS). With this method, tiny particles of plastic, ceramic, glass, and metals are fused together by heat from a high-power laser to form a solid, three-dimensional object. SLS is a faster process than FDM and supports a larger variety of materials, such as polymers (commonly known as nylon), and polystyrene (a steel, titanium, and alloy mix).

The third process is called stereolithography (SLA). Here, excess plastic liquid is cured and hardened to form a solid, three-dimensional object. A faster process than FDM, SLA supports photopolymer materials that differ in how the layers are built.

All of these technologies are quite mature. However, the speed issue has been a barrier for companies ranging from consumer goods to big machinery manufacturers and large industrial players looking to adopt 3D printing in their processes. For instance, with FDM technology, 3D-printing speed is between 50 to 150 mm per hour. For SLS, it's up to 48 mm per hour, and SLA reaches 14 mm/h. A study was conducted regarding the printing of a 51-mm-diameter complex object, and results showed that the printing took 11 hours with SLA and three hours with SLS. Such speeds cannot live up to the expectation of replacing the assembly line in a factory.

Beyond the Big Three

wever, the landscape for 3D printing is quickly changing. For instance, companies are beginning to invest in continuous liquid interface process (CLIP)that usesphoto polymerizationto create smooth-sided solid objects of a wide variety of shapes to increase speed and accuracy of the 3D-printing process. And while 3D printing has been widely adopted in product prototyping, with just a CAD file, it's much faster and less costly to put design ideas into tangible product. With 3D printing, there's no need to have different molds or tooling for each revision of the design, enabling much faster iterations during the design phase.

Take a look at how businesses from consumer goods to the manufacturing industry have all been utilizing this technology to advance their competitive edge.

Remote and on-demand manufacturing feature of 3D printing helps to digitalize and disrupt the supply chain. With the easy setup of 3D printers and stored digital print, businesses that have to operate in remote locations, where it may take a very long time to deliver the broken parts, may significantly benefit from the ability to manufacture the spare parts with 3D printing. This approach eliminates the inventory cost for storing expensive spare parts and avoids revenue loss when the machinery goes down.

Businesses that are required to store up spare parts for their machines and appliances for many years can instead print the spare parts, which helps minimize production and warehouse cost. Manufacturers also eliminate the shipping cost by localizing the production. With 3D printing, manufacturers can lean-produce according to demand, as needed, and despite a higher per-part cost, the supply chain is highly simplified.

Complex geometry also is possible with 3D printing, which isn't the case with traditional injection molding. As a result, parts can be combined. Companies developing design software have been working to provide automatic design optimization for 3D printing to achieve design advantages made only feasible by additive manufacturing. With this great feature, aerospace and automotive has been exploring how to combine parts to reduce the cost and complexity of assembly, reduce the weight, and further lower energy costs by using lighter materials and increasing the heat dissipation.

Expanding Applications

Perhaps the greatest advances in 3D printing have been delivered in the important role of mass customization and production in the medical field. Products such as Invisalign would be absolutely impossible without the help of 3D printing.

We have already seen 3D-printed human organs in study environments and medical instruments such as personalized prosthetics for amputees. Customized auditory implants are also great candidates for 3D printing.

On top of that, 3D-printed miniaturized bio-robots have shown the ability to find their way through a human body to carry out repair jobs on a target organ or deposit medicinal drugs. At Harvard, nano-robots containing DNA strands have been printed. These are capable of opening up selectively whenever they meet cancer cells, releasing specially calibrated antibodies to destroy these target cells. We expect the biology and life sciences industry to experience radical transformation through all of these findings.

There are still some obvious limitations or obstacles of 3D printing. With its price and speed, it's still hard to justify it replacing traditional manufacturing in terms of mass production. With the additive manufacturing's layer-by-layer feature, post-processes are required to achieve the same mechanical properties and product quality. Legally, ambiguity still exists in regards to who will take the legal responsibility of a malfunctioned product. The intellectual-property protection also raises certain concerns. Even with these setbacks, technically, the possibilities of 3D printing are infinite and will no doubt keep opening the door to new products in a variety of applications.

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