



# Additive Manufacturing

A data innovation case study by **copia**

Just as the Gutenberg printing press paved the way for information and ideas to be spread by allowing mass communication, the advent of 3D printing brings the ability for anyone to share design concepts and create physical goods on demand, anywhere. Additive manufacturing can make things faster, better and cheaper. It reduces waste by eliminating inefficient shipping, transforming disposable items into easily repairable goods, and minimizing inventory with custom manufacturing processes. Communities of hobbyists and professionals have created a vast collection of digitized designs, creating a marketplace for a cottage industry of designers. Large corporations like GE are crowd-sourcing designs and using 3D printing to manufacture parts for everything from brackets to jet engines. The 3D printing industry has been around for 30 years, with estimated revenues of nearly \$4 billion in 2014 and projections of a \$70 billion industry by 2030. However, intellectual property policies have hindered the 3D printing industry, and increasingly restrictive policies could harm this innovation in unintended ways.

## IMPACT

The reach of 3D printing spans the entire spectrum of the economy — from individual users to global corporations and from the healthcare sector to the aerospace industry. Additive manufacturing will be as universally disruptive as the cellular telephone industry. The price of a 3D printer is increasingly more affordable, and more and more everyday items are being manufactured using 3D printing.

In medicine, 3D printing has been used to fabricate prosthetic limbs economically and custom-fit for the patient. The results have been especially dramatic for children who quickly outgrow or break parts of their prosthetic devices, as 3D printed replacement parts can be rapidly exchanged, modified and improved. The ability to print precise and custom shapes also allows for 3D printed bone implants such as artificial vertebrae and bone scaffolding that can save patients from limb amputations. Surgeons can now print accurate 3D models of brain tumors to study before they attempt an operation, to help plan minimally-invasive approaches. Research on living organs grown using 3D printing technology

is still in an experimental phase, but there are several groups working on growing thyroid, liver, kidney, and pancreas replacement organs, as well as 3D printed skin grafts.

For more traditional manufacturing, the automotive industry is using additive manufacturing for rapid prototyping development, and one demonstration at the North American International Auto Show in Detroit showed a 3D printed car which could be printed in 44 hours. Major aerospace companies employ additive manufacturing for prototyping, and newer jet engine designs have 3D printed parts that are lighter, stronger and more efficient — and can't be made using traditional manufacturing processes. NASA has a 3D printer on the International Space Station that it can use to send custom tools to astronauts, saving valuable time, space and weight in an environment where transport costs are a premium. Additive manufacturing technologies also made it possible for a team of part-time scientists, working in several different countries, to design and build a working lunar rover for low-cost commercial space exploration.

On the more down to earth impact, 3D printing is finding its way into the arts and fashion and cuisine. Several projects are using 3D scanning and printing to make digital archives of priceless artwork. Artists and designers

have a new medium for constructing objects that would have been too expensive or simply not possible without 3D printing techniques. Textiles are typically mass produced in various sizes, but with 3D printing, clothing could be made to custom dimensions without wasteful inventory. In a Dutch supermarket chain, shoppers can buy a custom cakes with 3D printed decorations made of chocolate.

Thousands of schools around the world are already integrating 3D printing lessons to introduce engineering concepts and teach Science, Technology, Engineering and Mathematics (STEM) principles. History lessons can include 3D printed replicas of historical artifacts. Biology classes can incorporate 3D printed models of animal anatomy. Chemistry models for atomic and molecular structures can be printed at will. Students can be creative and produce 3D printed artwork. Ultimately, teachers can have access to an unlimited amount of visual aids to make material more engaging and easier to understand.

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#### **POLICY IMPLICATIONS**

With all the benefits of 3D printing, the technology also has a disruptive side since it allows anyone to create, copy, and modify objects. While that is empowering for many individuals in our information age, it can also have

an impact for existing intellectual property laws.

The affordability and availability of 3D printers has grown recently as a few key patents have expired, allowing for more companies to sell 3D printing technology without licensing or lawsuit concerns. The prices of printers have fallen and will continue to come down as more competition enters the market. Before these key patents expired, the available technology without licensing requirements was restricted to processes that produced only flimsy plastic objects. Still, the 3D printing industry involves a few companies with a combined total of over 1,500 patents, so while a handful of early patents may have already expired, a daunting patent thicket still awaits entrepreneurs who might want to enter the field.

The hardware may become more available inevitably, but the issues of copyright and trademark may also limit the kinds of items that are produced. More than a few frivolous notices have been sent to take down digital files for the designs of objects with dubious intellectual property coverage. A recent prominent example would be a cease and desist notice for the printable design of the Left Shark from the Katy Perry halftime show at SuperBowl XLIX — since a shark costume is generally not subject to copyright protections. As 3D printing becomes increasingly commonplace, more and more of these legal threats could pose a Napster-like situation for digital design files.

Certainly companies that used to be able to have something of an exclusive on designs may find their positions challenged by the ease of copying product designs, and there may be pushes for new forms of intellectual property protection for physical objects — perhaps ones that try to mimic aspects of current laws, such as anti-circumvention rules or specific rules against making copies of certain products you've purchased. Laws like these could greatly slow down innovation in the 3D printing space.

When many objects can just be printed out, shipping and transportation needs change. Amazon recently applied for a patent on a plan for mobile vans with 3D printers that will print out what you ordered as they drive to your home.

The rise of additive manufacturing could change the way society views objects and possessions, creating certain policy challenges. When things can be printed on demand, there may be less concern over ownership of items, which could lead to greater shared resources.