Additive Manufacturing: from enthusiasm to adoption to production… but where does intellectual property fit in?

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Additive Manufacturing (AM) technologies, also known as "3D printing", have been around for over 30 years. However, it is only in the last five years that a strong interest has been observed in the market, especially with the appearance of an abundance of machines, materials (from rubber to sugar to titanium and even concrete!), service providers and increasingly accessible applications. With uses as diverse as automobiles, cakes, airless tires and even ribcage prostheses, the emerging AM technologies can certainly fire up the imagination!

This is mostly due to the fact that many pioneer patents related to AM machines have recently expired, the patent protection normally lasting 20 years. Technological advances in this field, and increasingly wider use of these technologies, have resulted in both the U.S. and European patent offices (USPTO and EPO) creating new classifications for patent applications related to, for instance, different types of AM processes, machines and materials used. Increasingly complex AM applications are appearing monthly and are intended for mass production (not just for rapid prototyping, as was originally the case). But now the growing popularity of these technologies is raising questions about AM's impact on intellectual property. Let's begin with a brief overview of AM, some industrial applications of the technology and their implications for intellectual property, one layer at a time!

Definition of Additive Manufacturing

Additive manufacturing consists of fabricating parts or assemblies layer by layer, or through the selective deposition of material, with various materials such as metals, plastics, ceramics, composites, paper and even biological material using a digital file. According to standard F2792-12a of the ASTM (American Society for Testing and Materials), AM processes can be classified into seven categories. The most commonly used processes for the manufacture of production parts (or tooling) include powder bed fusion (metal or polymer), material extrusion and binder jetting. The value chain, or the series of steps required to create a part or assembly via AM, initially consists of generating a digital model of the part using Computer-Aided Design (CAD), then converting the CAD file into a format compatible with an AM machine and then transferring the file to the AM

machine. The AM machine is first prepared for manufacturing by defining parameters such as layer thickness and scanning speed of the material deposit head; then the part can be fabricated. Finally, the part is removed from the machine and a post-processing step is carried out based on the process used.

Intellectual property

The steps in the value chain that carry certain risks relating to intellectual property are those involving the generation and transfer of digital files; in other words, the CAD file and/or the file containing instructions for the AM machine. Why? Because all the research and development investments and efforts are integrated into a digital file that is likely to be distributed rapidly around the world. Decentralization of manufacturing is a major benefit of AM, but it does carry certain risks.

The digital file is usually obtained from a CAD software program, but could also be generated by digitization using a 3D scanner. A 3D scanner allows one to collect data on a part as point clouds that is turned into a file that is compatible with an AM machine. Creating a file that is compatible with an AM machine using a scanner can be done very quickly and allows one to copy a part.

The use of an additional method in the value chain, called topological optimization, may contribute to reduce the weight of parts produced by AM. If used in the process after the step of generating a digital file (which is used as the input), topological optimization helps determine the optimal distribution of material within a design space that is subject to given constraints. Since additive manufacturing consists of fabrication by adding material, design guidelines specific to this fabrication principle, and not to removal (subtractive manufacturing) or deformation of material, as is the case with traditional manufacturing methods, must be applied. Design expertise for additive manufacturing, or DfAM, is therefore also included in the digital file transferred to the AM machine. This digital file has significant financial value, since it includes all the information about the geometry of the part, as well as its manufacturing parameters. This value is such that some companies do not market the object produced by AM, but rather the CAD file used to make it.

But could this digital file be protected by a patent or by industrial design? A patent is a right to prevent a third party from manufacturing, using or selling an invention, which must be either a product, a composition of materials, a machine or a process. An industrial design, on the other hand, enables the protection of the visual characteristics of a finished product. Therefore, the digital file cannot yet be protected as such by these types of laws. Only copyright protection can be applied. However, it may be difficult in the future for copyright holders to monitor the transfer of files that may infringe on their rights, and to do so worldwide. In the same way, the owner of a patent on a product or machine not only needs to monitor the market for infringing products, manufactured either traditionally or with AM, but also for digital files: once these are transferred to an AM machine, they can produce a physical representation of the product or machine.

In addition, the holder of a trademark, which could be related to the visual aspect of a product, such as the shape of a Coca-Cola™ bottle or even the touchpad of an iPhone™, needs to be on the lookout for any reproductions of its brand name that may have been

facilitated through the use of AM. The action of making a piece of chocolate in the shape of several triangles and affixing to it a trademark such as Toblerone™, for example, would constitute a violation of the holder's rights.

On demand manufacturing and liability

In addition to considering intellectual property rights within the framework of AM use, the aspect of liability must be taken into account. Let's take the example of the production of spare parts. This is an application that involves a great deal of added value compared to traditional manufacturing processes, since no tooling (e.g. moulds, dies) would be required for AM, so a short production run could be profitable. Despite this market benefit of custom manufacturing, there are some liability risks. It's easy to see that a digital file used for manufacturing could end up in the hands of various people, since transfer of the file is quick and easy. Even if they are not the creators of the file, these individuals could manufacture, use and market the resulting part. So who would then be liable if an accident should result from the use of a part (e.g. a spare part) that had been manufactured by this third party? Would it be the person who designed and modelled the part, the person who scanned the part to reproduce it, the person who marketed the digital file or even the person who made it? There are now some means of tracing the manufacturer and differentiating between an original and a copy that have appeared on the market. For example, adding nanomaterials or a material with a specific composition to a part during its manufacture are ways to help limit liability issues in the event of failure or accident.

Conclusion

In conclusion, AM technologies are constantly evolving, for example in the extrusion of metallic materials, molecular scale AM and continuous photopolymerization process. These advances are helping to push the limits in terms of the cost and speed of manufacturing. The AM machines available on the market are increasingly efficient and affordable. However, adoption of these technologies is a gradual process, and industries will need to develop their competency in design for AM, as well as topological optimization, development of cost models, and tailoring their supply chains for AM. It can therefore be expected that the legal framework will also gradually evolve, in tandem with the development of AM, its applications and the ecosystems related to these technologies. Challenges will, however, remain within the legal framework, related to compliance with a holder's intellectual property rights, given the rapid distribution of digital files used in AM. Inventors can protect their innovations, by means of industrial design or patents, independently of the process used to make them. The counterfeiting principle applies regardless of whether products are made using AM or traditional manufacturing processes. Nevertheless, a patent application should cover any future facets of an invention, including the possibility of a part being produced by AM.