



INVESTMENT STRATEGY UPDATE

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3D PRINTING

Perhaps better described as “additive manufacturing,” the so-called 3D printing industry comprises a relatively new group of technologies that allows the creation of solid objects from digital models. We believe the moniker is somewhat misleading, because although some 3D printers and their components are reminiscent of traditional office document printers, their purpose and the end markets they address are clearly more industrial. In any case, increased use among design and engineering professionals and, more recently, hobbyists, has highlighted the value of 3D printing and raised the timeless question: Will this be game-changing? While we believe that it already is for some applications, we do not believe that traditional manufacturing processes will be made obsolete over any reasonable time frame. What 3D printing does is make life better for consumers and make design processes more efficient for companies. As such, it is generally a positive development, and the purpose of this piece is to explain the process and look at its investment potential.

The Basics

Work on the concept of additive manufacturing began in the 1960s, but really came to fruition in the late 1980s when the founders of today’s two dominant 3D printer makers invented their processes, built their first machines, and started their businesses. Sales of 3D printers, supplies, and services have taken off in the past few years, and comprised a \$2.2 billion market in 2012.

The fundamental difference between 3D printing and many traditional manufacturing processes is that it is an additive process, rather than a subtractive one. In other words, instead of taking a solid block or sheet of a given material and drilling, milling, cutting, or stamping it into a certain shape, which can be fairly wasteful, a 3D printer builds an object by depositing layers of material in precisely the shape desired.

There are seven unique technologies or processes identified by the American Society for Testing and Materials, but three of them account for 75% of machines installed at 3D printing service providers. The most popular is stereolithography, in which an ultraviolet laser is used to cure successive layers of a liquid polymer. It is a fast process that produces products with high surface quality, but is relatively expensive. Next is materials extrusion, in which a heated substance is forced through a printer nozzle onto a build platform. While inexpensive, this process is slow and produces a lower quality product. Powder bed fusion is the third most prevalent process, where a laser or an electron beam melts a powdered raw material, which then solidifies into the desired shape as it cools. This is the most expensive option and may require further finishing after printing, but it can be used with a wide range of materials to make structures with complex geometries.

From humble beginnings, the industry has created printers that can work with a wide variety of materials. Raw inputs include thermoplastics (like those used to make Lego bricks), metallic or ceramic powders, paper, and even organic substances. In 2012 photopolymers were 50% of the materials used in 3D printing, with metals being only 6%. However, with such a wide variety of inputs, the outputs are almost unlimited, from simple plastic consumer products, to high-spec metal parts for aerospace applications to, believe it or not, human tissue.

Who Benefits?

The advent of 3D printing presents a number of advantages. One is the ability to make complicated objects in one manufacturing process, rather than having to make the individual components first and then assemble them. A second advantage is the efficient use not only of raw materials but also of energy. A study by Michigan Technological University of the energy required to print three items at home versus obtaining them through the normal manufacturing/shipping process found that 3D printing cut energy use by approximately 50%. Similarly, while the savings are impossible to quantify, in general, the basic concept of laying down a material in the precise desired shape is obviously less wasteful than removing excess from larger pieces of material.

The most important benefit, however, and the real reason why 3D printing is rapidly becoming an important part of the manufacturing landscape, is the ability to customize. With a minor tweak to a design in a software file, rather than a complete re-tooling of a production line, the output can be changed. And perhaps more importantly, with a completely different design file, the same machine can make a completely different product. This may not be relevant to a company that mass produces a limited line of products, but it is game-changing if the product is unique, such as a prosthetic limb, hearing aid, or dental implant. In fact, medical and dental applications are the third largest end market (16%), after consumer products (22%) and automotive (19%). So the beneficiaries are not only companies that can use 3D printers to create prototypes of new products much more quickly and cheaply than through traditional methods, but the consumers who get a better fit, a design element that is utterly unique, or the ability to make an otherwise impossible-to-find replacement part.

Of course, the technology is not yet advanced enough to make a 3D printer an indispensable household appliance. A desktop version can indeed be had for less than \$1,000 but its capabilities will almost certainly be constrained to relatively small, monochromatic plastic items. For now, more complicated products may be ordered from printing service companies that can afford to invest in industrial-grade equipment. But who knows? As the various technologies improve to the point where machines with multiple print nozzles enabling printing with multiple materials and colors are easily affordable, it may actually become possible to realize a certain level of self-sufficiency, producing not just amusing trinkets, but common household necessities--from hardware, to clothing, to food--with the proverbial touch of a button.

Who Is Threatened?

“3D printing is a gimmick” says Terry Gou, President of Foxconn, the world’s largest electronics contract manufacturer and assembler of the iPhone 5S. For all the hype about 3D printing, there is a reasonable limit to how much disruption it can cause. As noted, the biggest benefit is in customization, but there are plenty of products that don’t need to be customized. So traditional metal stamping and bending isn’t going to go away as long as the volumes are high enough to justify the capital expenditure on tools. Also, raw materials are an important cost component and currently they are much more expensive when bought as 3D printer supplies than when purchased in bulk for traditional manufacturing processes.

There are also concerns about intellectual property rights. In the world of music and movies, where digitization allows for infinite identical copies of original material, copyright infringement is a major concern for creative artists and companies. Because almost anything can now be digitally scanned and reproduced on 3D printers, with varying levels of quality based on the price paid, the same concerns about intellectual property theft apply. Because copyrights apply only to intangible or aesthetic creations and last much longer than the patent on a functional item, 3D printing poses a much broader potential threat of infringement.

Finally, as with so many technological advances throughout the centuries, it is easy to envision scenarios where the biggest losers will ultimately be the workers who assemble products. 3D printing is in some sense the ultimate example of robotic manufacturing. The more complicated the product that can be built in a printer, the less need for human intervention in the process.

Investment Implications

While we are certainly not as dismissive as Mr. Gou of the potential for this relatively new technology, we believe it will remain complementary to more traditional manufacturing processes for the investable future. Given the range of products that can be produced and the level of customization that can be achieved at a reasonable cost, there is definitely enough substance to make this a transformative industry.

Although one can achieve direct exposure to this theme, the investment case is not so straightforward. The two dominant suppliers of printing equipment (who also happen to have been founded by the inventors of two of the key additive manufacturing processes) have been steadily consolidating the industry through mergers and acquisitions. Both are publicly traded and have similar growth rates and valuations. And there’s the rub. As value investors, we pay close attention to how much we pay for each dollar of projected future earnings, and these companies are simply too expensive right now, as stock valuations often are in the early stages of revolutionary technological innovations. It is also possible that today’s leaders cede their position or disappear entirely as the winning production processes are identified and perfected. Thus, we believe the current buyers may be a little overexcited. But growth is rapid, so we will keep our eyes on the leaders as well as on their up-and-coming competitors.

Another logical way to approach this industry is to invest directly in the software side of 3D printing. Printers can only print from a digital design, which means either a scan of an existing object or a brand new design created with the help of a computer. Consequently, the area of computer-aided design is of interest to us, with the same caveat that we are looking for potential investments with reasonable valuations.

It is also clear that innumerable companies of all sizes will benefit in some way from the implementation of 3D printing, but we are not yet aware of any sizable publicly traded companies where the economic return would be material enough to form the basis for an investment decision. More generally, however, we believe that the progress made in 3D printing proves that technological innovation is not dead and that American manufacturing is indeed in the midst of a renaissance. This important trend deserves our ongoing attention.

Market Outlook

After a surprisingly strong 2013, the tenor of the financial markets seems to have changed. Stocks have struggled to make headway and interest rates have declined, while emerging market weakness and global deflation risks became the crises *du jour*. It remains to be seen whether the corrective process in stocks that began in mid-January will continue, but frankly we would welcome it if it did. We believe that a continued correction here would amount to a pause that refreshes, thereby allowing for a longer-lasting bull market.

Historically, bear markets of 20% or more have occurred for two primary reasons. First, there is threat of an impending economic downturn, often brought about by a restrictive Federal Reserve Board raising interest rates to combat inflationary risks. Second, stock market valuations and investor expectations simply become too extreme, as they were, for example, in 1987 or 1999. Neither reason marks the current situation. While the Federal Reserve is steadily reducing the amount of bonds it buys in the open market, monetary policy is still extremely accommodative. Valuations, while higher than a year ago, are by no means excessive. And economic indicators in this country seem to be predicting continued growth, rather than deceleration and the risk of recession. As long as these conditions persist, cash and bonds will continue to serve as stabilizing elements of a portfolio, but will not provide meaningful positive returns. Correction or not, stocks remain the most attractive asset class.

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