■ *MDM Special Report: Disruptive Technologies*

3-D Printing Drives Supply Chain Shift

Access, customizability may make manufacturing a more local endeavor

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The media is talking about 3-D printing, also known as additive manufacturing, more than ever. But adoption of the technology in everyday use is far from widespread. This article examines the role of 3-D printing in manufacturing today and how it might change the supply chain in the future.

This article is part of MDM's Disruptive Technologies Special Report.

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By Jenel Stelton-Holtmeier

A lot of excitement surrounds 3-D printing in manufacturing, and for good reason, says Jason Young, CEO of diversified manufacturer ARC Group Worldwide, DeLand, FL. "I think manufacturing is going change pretty significantly over the next 20 years or so, and 3-D printing will probably be one of the key drivers of that change," he says.

The potential benefits of 3-D are easily understood: faster time to market for new products, shorter lead times and easier customization, just to name a few. Because of that, the impact will be felt all along the supply chain.

But today, "there are far more people not using 3-D printing than are," Young says.

"With 3-D printing, we aren't even in the basement in terms of really having a good grasp on how that technology might change value chains," says Guy Blissett, specialist leader in wholesale distribution at Deloitte Consulting. "It has a very long way to go in terms of speed, precision and cost to fully transform supply chains in general."

Current Day

Even with the attention it's receiving, evaluating the role of 3-D printing in today's manufacturing environment is difficult, according to Tim Shinbara, technical director of the Association for Manufacturing Technology. Observers can see the technology being used in certain industries, such as medical or aerospace, but the industrial space is a bit further behind on the adoption scale.

In addition, people not already involved in the process tend to lump different technologies into one when trying to measure its prevalence. "There's a lot going on already with 3-D printing as it relates to polymers," says Heidi Hostetter, director of operations at Faustson Tool, a provider of high-precision machining to the aerospace, aeronautics, defense, energy, medical and semiconductor industries based in Arvada, CO.

In many ways, 3-D printing with plastics and polymers has been commoditized, with companies such as FedEx Office and Staples offering the service through some retail locations.

But 3-D printing with metals and alloys is a different story. "Metal is the next big wave of opportunity," Young says.

That's not to say that 3-D printing doesn't have a role in manufacturing today. Compa-

nies such as 3D Material Technologies, an ARC Group company, are already using 3-D printing to speed prototype development. "Machining might be faster if you already have the design, and you're already running the machine for that product," Young says. "But on a general basis, 3-D printing is always faster for prototypes for very small production runs." And it is often less expensive than traditional machining for these limited runs.

That is because there is no need to build a mold for the prototype and calibrate the machine to those specific parts. All of that work is done through the design and engineering process and input into the printer.

Current use of 3-D printing expands beyond prototypes, however. "What you don't see behind the scenes is that half the business in additive manufacturing is tooling, all the products that can be made with 3-D printing that are used to make the other parts traditionally," Shinbara says. "That story hasn't really been told."

In the aerospace industry, "3-D printing of metals is allowing us to test if theory even works," Hostetter says. For example, before electronics and other parts can be put into a shuttle, you have to make sure all those items will fit into the shuttle housing, she says, and that's where 3-D printing comes in. "That's two-thirds of the recipe."

Barriers

Cost is still a significant barrier for 3-D printing. High-end precision machines can easily cost more than $1 million, Hostetter says. And the alloy powders and materials the machines use can be expensive, as well.

In addition, many of the materials used in the process, such as titanium alloy powder, are volatile and require separate licensing to purchase. Those licenses can cost $40,000 to $60,000 each, she says.

Cost is part of the reason the early adopters are in aerospace, medical and dental industries, Shinbara says. "They have a way to amortize high-risk high tech across different platforms," he says. "Not everyone does." But even in those industries, if a company isn't a tier one supplier, the cost may put this technology out of range.

But cost is not the only barrier. Designers may have more freedom and flexibility to move an idea from "art to part," Shinbara says, but manufacturers are still limited by what materials are reliable, certifiable and available – a selection that is growing but is still limited right now.

There is also the complexity of the 3-D printer market. "There are thousands of them out there," Young says. "And they're all different technologies." You have to know what it is you want to do with the technology and then figure out which of the options will meet that need best.

Even if a company decides to outsource the actual 3-D printing part of the process, options in some ways are becoming more limited. "There just aren't a lot of 3-D printing services out there right now," Young says. And many of those that used to be accessible have been purchased by large manufacturers for internal product development, such as GE's purchase of Morris Technologies in 2012.

The talent needed to really take advantage of 3-D printing's capabilities is also limited, Faustson's Hostetter says. "Colleges don't have a strong curriculum to support design engineering efforts," she says. Designers need to better understand how those alloys work as powders and how they react as they are melted down and extruded by 3-D printers so they can include those considerations in the designs.

The Supply Chain of the Future

The challenges may be slowing adoption and application of 3-D printing, but none are insurmountable. And once they have been overcome, 3-D printing has the potential to fundamentally change manufacturing and how products go to market, Shinbara says.

"3-D printing, cloud-based design, cloud-based manufacturing – all of this enables folks with fewer resources to become more important in the industrial supply base," he says. The local/regional supply base will have more capabilities to be more responsive to local and regional needs. As a result, reliance on large facilities that can produce high volumes at low cost could lessen.

Because 3-D printers don't require molds or extensive calibration to produce even extremely different parts, it also opens the door for more product customization. "Clusters" of "makers" could form around this technology, sharing production and research costs to meet the needs of local customers more efficiently than large manufacturing facilities.

"Washington may call it a reshoring of the major jobs back from China to the U.S. or North America, but what we're seeing with 3-D printing is that it's more than just reshoring," Shinbara says. "It's really getting back your blacksmiths, silversmiths, cobblers of your local/regional village."

Distributors will have a major role in the village, Shinbara says. They're the ones with the

local market knowledge; they're talking with the diverse customer base and will be able to identify demand trends as they emerge. "They will be the ones to drive this shift as they uncover what their customers really want. And they will be the ones who bring this information to their suppliers," he says.

While the return to a "maker village" may still be a ways down the road, 3-D printing will likely continue to improve the time it takes to get products approved and brought to market, Faustson's Hostetter says. "In 10 years, production windows won't look anything like they do now," she says.

For example, Faustson designed and manufactured an optical substrate for NASA's Kepler spacecraft launched in 2009. It took 18 months to prove out that part at the time, Hostetter says. As 3-D printing advances, that same process could likely be done in less than two months.

"Manufacturing is still stuck in this really long convoluted supply chain with long lead times," Young says. "3-D printing will be one of the main drivers in changing that and reducing the time to market."

Because of the volatility and specialized knowledge required to work with metal alloys, manufacturing – even with 3-D printers – will likely remain the purview of the manufacturer, Young says. "While people call it printing, it's still manufacturing at the end of the day," he says.

Printing with polymers, on the other hand, may open opportunities for distributors to produce some products for their customers, Deloitte's Blissett says. "Think about the electrical distribution business, the boxes that house much of the electronics in houses, your light switches and your outlets, the box that sits in the wall that holds the electrical for that. The ability to print that out rather than import it from halfway around the world could have a pretty significant impact," he says. But the cost of 3-D printing still has a long way to move before that becomes a factor.

"The way we have viewed additive is much more a complementary, augmenting tool to traditional means than a disruptive substitute," Shinbara says. "If I'm a manufacturer and my shop is full of traditional technologies, I should not be thinking I'm going to lose work because I don't have additive capability; I should be looking at it as what orders am I not getting because of either affordability or complexity that I could with additive."

In other words, Shinbara says, traditional manufacturing methods are not going away any time soon, but the new technologies are and will continue to have an impact by enhancing current capabilities.