Global Trends in 3-D Printing

Christine Kobza, Office of Industries
Christine.Kobza@usitc.gov, (202) 205-3187

While 3-D printing has enormous potential to reshape global manufacturing and supply chains, uncertainty still exists regarding the feasibility and speed of its implementation. This EBOT is the first in a three-part series exploring global trends in additive manufacturing and addresses the leadership of the U.S. in 3-D printing as well as the challenges to the adoption of this technology.

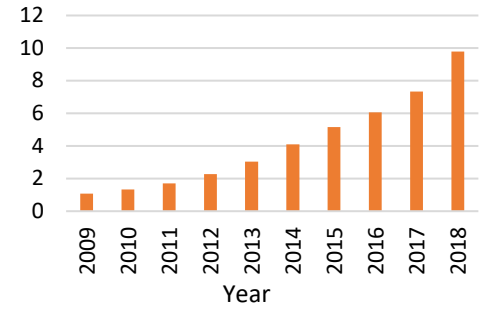
What is 3-D Printing?

Invented at MIT, 3-D printing is a type of additive manufacturing that produces 3-D objects by building layers of material upon each other. Whereas traditional manufacturing cuts away from or molds existing materials, additive manufacturing uses raw metals and plastics in forms of powder or liquid to build a product from the ground up. In the 3-D printing process, a modeling software or computer aided design creates a product design file that the printing equipment then reads and uses as the blueprint for building the product. This process provides more customization and design complexity than what is possible in traditional manufacturing, allowing for a wider range of applications. Manufacturers such as General Motors, BMW, and Boeing have used 3-D printing to create aircraft and vehicle parts. Firms like SmileDirectClub and Under Armour have used 3-D printing to create individualized consumer products such as dental aligners and sports shoes. The U.S. Air Force has also used this technology to produce metal aircraft parts and even replace broken toilet seat covers on the C-5 Galaxy aircraft.

Growth of the Industry

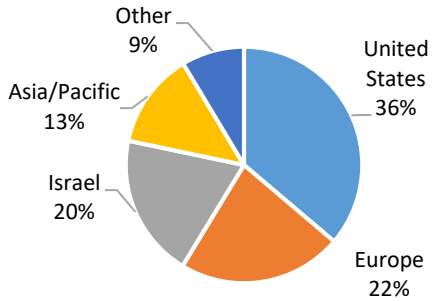
3-D printing has grown exponentially in recent years and will likely continue to grow in the coming years. While it took the industry 20 years to reach one billion dollars in sales of products and services worldwide, it took only five years to reach two billion dollars. In 2018, the industry generated $9.8 billion in revenue, growing 33.5 percent from 2017, as shown in figure 1. This growth corresponded with a growth of manufacturers and sales of additive manufacturing systems. Approximately 20,000 industrial systems[1] were sold in 2018, an increase of 18 percent from 2017. As of March 2019, 177 manufacturers worldwide produced and sold additive manufacturing systems, an increase of 31 percent from the previous year.

Figure 1.
3-D Printing Revenue, billions ($)



Source: Wohlers Report 2019

Figure 2. Total systems sold in 2018, by region of company headquarters



Source: Wohlers Report 2019

Main Players

North America and Europe are currently the leaders in 3-D printing, both in terms of machine production and installation. Figure 2 shows the share of industrial additive manufacturing systems sold in 2018 by companies headquartered in each geographic region.

[1] Industrial systems refer to machines that sell for $5,000 or more. The average selling price was $97,609 in 2018.

The United States and Europe account for more than half, followed by Israel and Asia/Pacific. Within the Asia/Pacific region, two-thirds of the region's industrial additive manufacturing systems are headquartered in China and Japan. Though the Chinese market for 3-D printers has grown in recent years, Chinese firms are not yet as advanced as foreign manufacturers in this area. However, in 2016 the Chinese government pledged approximately $56 million for 3-D printing R&D.

Box 1. 3-D Printing in the United States

In the United States, America Makes leads government additive manufacturing advancement and coordination efforts. Founded in 2012, America Makes is a public-private partnership led by the U.S. Department of Defense that serves to advance additive manufacturing capabilities in the United States and establish a domestic competitive advantage in the global industry. This partnership has more than 220 member organizations that include academics, government officials, and industry experts, and has generated over $275 million in investment.

Current Limitations to 3-D Printing Technology

Although 3-D printing has enormous potential for changing the nature of manufacturing, there are still gaps between its perceived capabilities and its current applications. It is likely that 3-D printing will serve as an addition, rather than a replacement, to traditional manufacturing. 3-D printing currently represents only 0.08 percent of global manufacturing. The technology is not yet used consistently for larger products, with approximately 56 percent of additive manufacturing parts used for end-use parts or functional prototypes used to test form and fit. Additive manufacturing is not always the most effective production process and machinery can be very expensive, especially when used to produce parts not designed for 3-D printing.

Additionally, the inputs and machinery for 3-D printing pose challenges to scaling. Production volumes are often lower than in traditional manufacturing and the dimensions of the machines themselves are generally not large enough for industrial production. In addition, raw materials for 3-D printing are typically polymers or metals whose prices have changed little in the past two decades and are 20 to 100 times higher than those used in traditional manufacturing.

Challenges to Widespread Adoption

The industry currently faces limitations that affect the uptake of 3-D printing technology. Firstly, many 3-D printing machines are not yet cost-effective and are too expensive for many manufacturers. Indirect costs associated with this technology also impair its implementation. For instance, firms may have to incorporate a comprehensive implementation of 3-D printing and restructure more than just their manufacturing process in order to make use of the benefits of additive manufacturing. 3-D printing does not offer an exact trade-off from traditional manufacturing but rather provides long-term benefits such as hyper customization and manufacturing flexibility that are not always directly quantifiable. Therefore, it can be challenging for firms to know how to make use of and convert to additive manufacturing technologies. In addition, there is little standardization for 3-D printing processes and materials, making it difficult to promote widespread use of 3-D printing. Furthermore, there is a lack of skilled labor in additive manufacturing and few pipelines currently exist to develop workers for these roles. However, these areas will likely continue to evolve as the industry advances, making 3-D printing a more integral aspect of modern manufacturing.

Sources: T. Wohlers et. al., Wohlers Report 2019, Wohlers Associates, Inc., March 2019; What is Additive Manufacturing?; S. Ford, https://www.usitc.gov/journals/Vol_VI_Article4_Additive_Manufacturing_Technology.pdf; D. Küpper, Get Ready For Industrialized Additive Manufacturing; J. Wübbeke et. al., Made in China 2025.