# Additive Manufacturing *in the United States*

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The US is still the largest economy for additive manufacturing (AM) products and services. Our research shows that it outpaces other countries by a large margin. An estimated 36.9% of all industrial AM systems sold worldwide in 2010 went to organisations in the US. This compares to Germany's 14.7% (second after the US) and the UK's 2.6% (number seven). When considering cumulative installations (1988–2010), the US had 41.1% of all industrial systems installed worldwide. The country with the second most cumulative installations is Japan, with 10.2%. Data for 2011 will be available in May 2012.

I've seen more interest in AM by the US government over the past year than ever before. In November 2011, the White House initiated a project to look at a wide range of implications associated with the technology and its future impact. As part of a March 2012 press release issued by the White House, AM was discussed as one of three areas of opportunity in product development and manufacturing.

Oak Ridge National Laboratory, Lawrence Livermore National Laboratory, and other national labs are increasing their experience and capacity in additive manufacturing. One of them hosted an intriguing AM event in February 2012 involving high-level officials across many agencies in Washington. The intelligence community is looking at possible threats associated with using AM in adverse ways.

ASTM International Committee F42 on Additive Manufacturing Technologies is more active than ever. The committee was launched in 2009 and has already published four standards, with many new ones in the works. Among the US organisations involved are Boeing, EWI, GE Aviation, Harvest Technologies, Georgia Tech, Goodrich, Honeywell, Lockheed Martin, Medical Modeling, Morris Technologies, National Institute of Standards and Technology (NIST), RapidTech, the University of Louisville, and the University of Texas.

The launch of new AM system manufacturers in the US continues. A seven-person startup company named Asiga, based in Southern California, introduced a very small 3D printer called Pico at EuroMold 2011 in December. The $7,000 system uses DLP and LED technology to solidify thin layers of photopolymer.

Essential Dynamics has introduced a syringe-based 3D printer called Imagine for $2,995 at the January International Consumer Electronics Show (CES 2012) in Las Vegas, Nevada. Similar to the Fab@Home machine developed at Cornell University, the Imagine system is capable of extruding many types of materials, including silicone, epoxy, organics, cheese, and chocolate.

Fabrisonic is a new company that was launched recently. It is a joint venture between EWI, an engineering consulting and manufacturing technologies company, and Solidica, Inc., the company that originally developed ultrasonic additive manufacturing (UAM) technology. UAM is a sheet lamination process that ultrasonically welds metal tapes to form parts. The process integrates CNC machining to ensure a good surface finish and fine detail.

The aerospace industry continues to influence innovation in additive manufacturing. Boeing now has 200 part numbers on 10 production aircraft. These numbers are expected to increase as new parts are qualified and certified for flight. Meanwhile, GE Aviation is excited about the future of building complex metal parts by additive manufacturing. The company plans to use additive manufacturing to produce two metal parts, a fuel injector and a leading edge for fan blades, for its gas turbine jet engines by early next year. These parts will be in full-scale production by 2016, with runs in the thousands. Robert McEwan, general manager of Airfoils and Manufacturing Technologies at GE Aviation, believes that within our lifetime, at least 50% of the engine will be made by additive manufacturing.

Morris Technologies has become the "go to" company in the US for services associated with the production of metal parts by additive manufacturing. Morris and its sister company, Rapid Quality Manufacturing, are now running 20 direct metal laser sintering machines from EOS. Most recently, Morris added an electron beam melting system from Arcam to its impressive capacity.

The Additive Manufacturing Consortium (AMC) is a US organisation launched recently by EWI. According to Ian Harris, AMC director, the consortium was developed in response to a need for collaboration, including design allowable data. The focus of the AMC is to advance the manufacturing readiness of AM technologies and to generate precompetitive data to benefit its members. The AMC consists of 33 partners from the private sector, US government, and research. Among them are the Boeing, GE, General Dynamics, Goodrich, Honeywell, Lockheed Martin, Morris Technologies, Northrop Grumman, Rolls-Royce, and Sciaky. US government agencies involved are the Air Force, Army, NASA, Navair, and NIST. The AMC also includes many research and business partners.

The RepRap community, which started at the University of Bath in the UK, has taken on a life of its own. Today, many small US companies and individuals are creating RepRap parts, subassemblies, and kits. An example is Aleph Objects, Inc., a company that offers a range of RepRap products, such as stepper motors, controller boards, power supplies, and nozzles. It also produces a fully assembled and tested LulzBot Pruza Mendel 2.0 (RepRap) machine for $1,200. The company is located just 19 km (12 miles) from Wohlers Associates, although I have not yet visited the company.

The speed at which RepRap and related projects have developed, and the number of kits and systems being purchased, is nothing short of astounding. At the same time, I'm seeing a lot of disconnect between the RepRap community and the established additive manufacturing industry. To some degree, neither group wants to acknowledge the significance, or even the existence, of the other. I certainly do not share this view because I believe both are quite interesting and important.

Interest in additive manufacturing is at an all-time high, especially in the mainstream press and among bloggers. Recent stories have appeared in USA Today, Forbes, and Bloomberg BusinessWeek, and more are on the way. This is generating interest among those who are not familiar with the technology. This, in turn, is creating a new level of excitement, followed by new ideas and pockets of funding. The snowball continues to roll and swell in size, and there's no end in sight.