

## Opportunities for Standardization in Additive Manufacturing

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*Standardization can play a role in the uptake and advancement of additive manufacturing and has gained increasing attention in recent years. This EBOT is the second in a three-part series exploring global trends in additive manufacturing and discusses areas of standardization, the leaders in its development, and its potential effect on trade and competitiveness.*

### Potential Areas of 3-D Printing Standardization

There are a number of areas in 3-D printing that require standards, ranging from the manufacturing process to the regulations governing the additive manufacturing industry. Although some standards are already in place and currently under consideration, there are clear opportunities and potential benefits of further standardization. Currently, few standards exist for the machinery itself regarding design, calibration, or preventative maintenance. There are also no metrics through which to compare the various additive manufacturing processes and equipment, and identify the most effective manufacturing process for a specific design. In addition, the industry lacks coordination on the quality, measurement, and sourcing of raw materials used in 3-D printing. Governments and regulatory agencies have few, if any, protocols for regulating 3-D printed items and are still working to develop roadmaps for the industries that utilize 3-D printing. Raw materials vary in their element and range from powders, to filaments, to liquids. Industry experts are still working to understand the changes that raw materials experience during the additive manufacturing process and identify the best material for its corresponding application. Uncertainties also exist with intellectual property and patent rights; because 3-D printing uses computer-aided design to model a product and sophisticated machinery to print it, there may be questions of whether the rights to the product belong with the original designer, the digital modeler, or the additive manufacturer. This question of ownership is also relevant for liability in instances where 3-D printed products malfunction or fail to perform.

### The Effect of Standardization on Industry Growth

At its most basic level, standardization in the additive manufacturing industry could ensure quality and consistency for producers and consumers. The industry may also be easier to regulate given that standards create metrics through which regulators can oversee the industry. More broadly, however, standardization could play a role in growing the additive manufacturing industry. For instance, clear standards may encourage the uptake of 3-D printing in new industries by making it easier for firms to navigate and make use of additive manufacturing processes. Additionally, as the skills and tasks in additive manufacturing become standardized, it may be easier to train workers and develop a labor force skilled in additive manufacturing.

### Leading Organizations in Standardization

The increasing attention to standardization is clear through the development of standardization bodies dedicated specifically to additive manufacturing in the past decade. These organizations promote and coordinate standardization

#### Box 1. NATO Involvement in Standardization

Standardization of 3-D printing is of interest to militaries. In 2016, the North Atlantic Treaty Organization (NATO) established an Additive Manufacturing Community of Interest in order to explore and coordinate member efforts and standards among its 29 member nations. Members participated in an Additive Manufacturing Business Process Wargame sponsored by the Office of the United States Secretary of Defense, America Makes, and the National Center for Manufacturing Sciences. NATO has also released reports exploring additive manufacturing advances and its potential uses.

on both international and domestic levels (box 1). The International Organization for Standardization (ISO) has a technical committee on additive manufacturing created in 2011. ASTM International, an international standards organization, launched a technical committee on additive manufacturing in 2009 that collaborates with industry, academia, and government representatives to conduct research and standards development. Among these standards are specifications for designs, materials and processes, terminology, and test methods. As of February 2019, ASTM has published 20 industry standards, five of which were published jointly with ISO. The World Customs Organization has also participated in standardization by creating a Harmonized System classification code specifically for 3-D printing machinery, which enters into force in 2022.

Though there are 25 participating member countries on the ISO committee for additive manufacturing, international participation appears to be concentrated in mostly Europe and the United States. These two regions have led efforts to advance and shape standardization internationally, as well as prioritized standardization domestically. European efforts for standardization are led by the European Committee for Standardisation, as well as advocacy organizations such as CECIMO<sup>1</sup>, a European association for manufacturing, which was responsible for lobbying for the creation of the new Harmonized System classification code for 3-D printing. CECIMO has helped to push the E.U. standardization agenda and listed improving standardization efforts as one of their ten key recommendations for the E.U. Strategic Agenda for 2019-2024. The United States is also a powerful force in standardization and has worked to create environments for research and coordination in this area. The United States member body of ISO is the American National Standards Institute, which helped to co-found the Additive Manufacturing Standardization Collaborative (AMSC) in the United States in 2016. The AMSC is a coordinating body that works to encourage the development of industry-wide standards and specifications. Though the AMSC does not develop standards, it does coordinate activity and identify areas of priority and improvement.

### **Implications of Standardization for Trade and Competitiveness**

Standardization is necessary for setting the foundation for trade in additive manufacturing. As 3-D printing products and equipment become uniform and clearly categorized, they will be easier to include in trade agreements. Clear regulations on intellectual property within the 3-D printing process, particularly for modeling software or computer-aided design files, may also encourage trade, as firms will have more assurance of protection and methods of recourse available for patent infringements. Additionally, standardization will improve the ability to collect data on the industry and track the movement of 3-D printed goods, allowing for further international cohesion and transparency. As standards begin to develop, countries have the opportunity to gain a competitive advantage by helping to shape them. The E.U. and the United States have recognized the important role of additive manufacturing in future growth and have taken a standard-setting role in the industry. Similar involvement from other countries may help to advance additive manufacturing and secure its place in the global manufacturing process.

**Sources:** America Makes & ANSI AMSC, [Standardization Roadmap for Additive Manufacturing](#); E. Malaty, [3D Printing and IP law](#); G. Coraggio, [Top 3 legal issues of 3D Printing!](#); CECIMO, [Press Release: CECIMO to Support Additive Manufacturing Standardisation with ISO Agreement](#); CECIMO, [Press Release: CECIMO Appreciates the Approval of a New Product Nomenclature Standard for Additive Manufacturing Machines](#); CECIMO, [CECIMO Recommendations](#); ISO, [ISO/TC 261 Additive Manufacturing](#); [ASTM International Additive Manufacturing Center of Excellence](#); ASTM International, [Additive Manufacturing Technology Standards](#); T. Wohlers et. al., Wohlers Report 2019, Wohlers Associates, Inc., March 2019; ANSI, [America Makes & ANSI Additive Manufacturing Collaborative](#); AM-motion, [Standardisation report: gaps and procedures](#).

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<sup>1</sup> European Association of the Machine Tool Industries and related Manufacturing Technologies (CECIMO)