



White Paper

Standards Development: Enabling Manufacturing Innovation and Accelerating Commercialization

Executive Summary

Standards are essential to accelerating the widespread commercialization of new technologies in the global manufacturing industry. In recent years, government and private-sector partners have made significant investments in strengthening the competitiveness of manufacturing¹. To ensure these investments yield returns as quickly as possible, industries must strive to align technology and global industry standards as they pursue the fastest path to commercialization.

Well-defined standards for emerging technologies are an essential asset to the global manufacturing community. Consensus standards ensure better structured communications – in which all parties speak the same language – for more efficient product testing and certification that enables faster commercialization. Additionally, standards are instrumental in helping to more rapidly allow multiple companies to compete at various points throughout supply chains, thereby reducing cost, improving competitiveness, and enabling continuous innovation.

Establishing international standards in fields in which technology is advancing rapidly is not easy. Partnerships with experts in standards development organizations (SDOs), such as ASTM International, offer a unique collaborative opportunity for newly

forming institutes, centers of excellence (CoEs), and other research hubs. Because the standards community has proven the potential of standards-driven approaches for accelerating commercialization, close collaboration between SDOs and innovation initiatives can be empowering. Creating a standards development roadmap in concert with a hub's or institute's technology roadmap ensures a clear, concise strategy for cross-functional planning and implementation and enlarges the manufacturing network.

By partnering with experienced SDOs, the innovation community can leverage their expertise, infrastructure, and resources (e.g., testing, validation, advanced manufacturing procedures) to develop in a timely way the international standards needed to accelerate progress while reducing standards development costs and duplication of effort. Working together to establish standards-driven priorities, institutes and SDOs can ensure better manufacturing quality, consistency, and relevancy in the increasingly competitive global manufacturing economy.

Introduction

While innovation initiatives (e.g., Manufacturing USA, CoEs, research hubs) represent an enormous opportunity for advancing global manufacturing and competitiveness, they are focused on advancing the leading edge of

About ASTM International

ASTM International is a globally recognized leader in the development and delivery of voluntary consensus standards. Today, over 12,500 ASTM standards are used around the world to improve product quality, enhance health and safety, strengthen market access and trade, and build consumer confidence. Our leadership in international standards development is driven by the contributions of our members: more than 30,000 of the world's top technical experts and business professionals representing 140 countries. Working in an open and transparent process and using ASTM's advanced information technology infrastructure, our members create the test methods, specifications, classifications, guides, and practices that support industries and governments worldwide.

Beyond standards development, ASTM offers technical training programs, as well as proficiency testing, and certification. All our programs complement our standards development activities and provide enterprise solutions for companies, government agencies, researchers, and laboratories worldwide.

ASTM's world headquarters are located in West Conshohocken, Pennsylvania, with offices in Belgium, Canada, China, Peru, and Washington, D.C.

¹In the United States, the Manufacturing USA Institutes alone represent a more than \$1 billion investment.

manufacturing technology, where standards do not yet exist. Fortunately, these institutes can leverage resources such as the voluntary consensus standards system, which continuously improves and adapts to meet the demands of the future. This system, which has been used effectively in the United States, is based on a longstanding public-private partnership world-renowned for its ability to speed innovation, foster competition, and bolster trade. Additionally, the system is supported by a wide variety of organizations, including the National Institute of Standards and Technology (NIST), with a track record of strong leadership, game-changing partnerships, and commitment to innovation and interdisciplinary approaches.

Without an integrated standards development process, the innovation community may encounter barriers (e.g., product testing, qualification, and certification) that slow time to commercialization, impacting competitiveness and innovation. Because the standards development process is inherently collaborative, it creates opportunities for a robust exchange of knowledge, expertise, and global perspectives that leads more quickly to the scientific consensus that can remove those barriers.

This paper explains the value that an integrated approach to voluntary consensus standards development can bring to innovation initiatives through



Early engagement in strategic planning to provide the interface between science and technology, research and market



Robust participation of all key stakeholders needed to ensure alignment of technology and process goals



Leveraging the **strengths of SDOs**, including speed, collaborative expertise, and agility

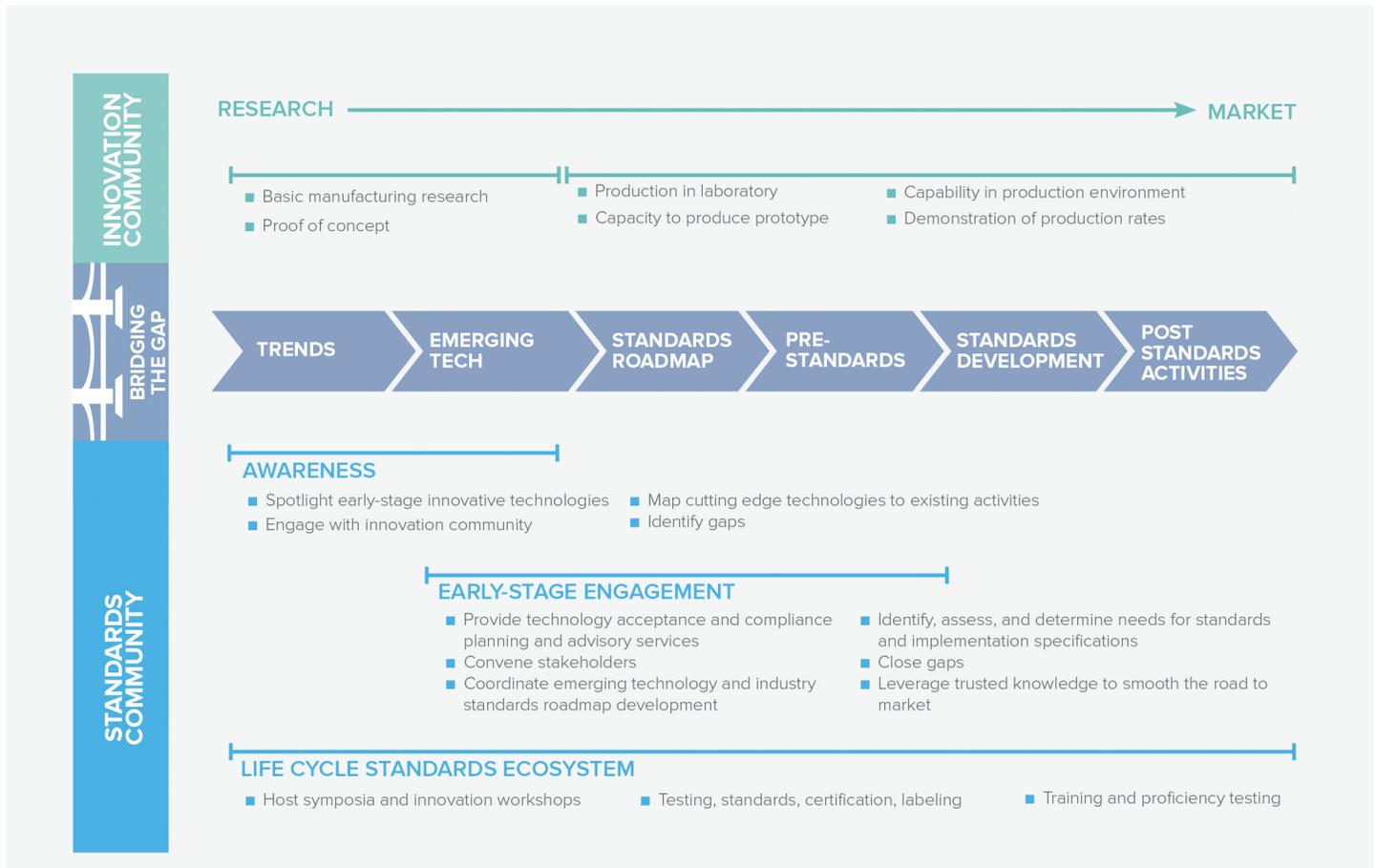


FIGURE 1 Collaborative early engagement helps bridge the gap between innovation and market, resulting in robust programs and services, developed by industry experts with standards as the foundation



Early Engagement in Strategic Planning

Creating a standards roadmap in conjunction with a technology roadmap builds a broad foundation for future innovation. Early, formal partnership between the innovation and standards-development communities helps prevent unnecessary delays and, in many cases, reduce time and expense. For example,

- Examining technology developments alongside the standards landscape provides a sound starting point for a thorough gap analysis and more effective strategic planning.
- Conducting a comprehensive audit of all standards-based resources an institute could leverage can reduce time required to develop final deliverables.
- Creating a list of relevant standards and the SDOs that developed them, for every project, can facilitate identification and required engagement level of key leadership and other resources.
- Aligning standards and technology allows the innovation community to develop standards that are market-relevant and robust, ensuring first-attempt compliance to save both time and cost.

Once an initial standards roadmap has been developed, partnership with SDOs continues to add value as the innovation community develops new guidelines and/or modifies existing standards for emerging technologies. Additionally, SDOs serve as a connector to the global community, ensuring the high-value knowledge of its global expert pool is leveraged in support of an institute's or hub's mission, as well as a conduit from research to development.

This collaborative engagement approach, illustrated in Figure 1, helps bridge the gap between innovation and market, ensuring that industry-wide standards are aligned with stakeholder needs to facilitate industry growth as new technology needs and developments emerge (see Case Study on page 4).



Robust Participation

Those who create and update technical standards – including ASTM International's more than 30,000 members – are on the cutting edge of many sectors, including both traditional and advanced manufacturing. These SDO experts collaborate on efforts to both anticipate and respond to emerging technologies in areas such as 3-dimensional (3-D) imaging, additive manufacturing, nanotechnology, smart textiles, industrial biotechnology, automation/robotics, and next-generation materials. Because their goal is to accelerate and maximize the potential of these advancements – helping businesses grow, compete, and create jobs – they effectively create a bridge between research and market.

Additionally, technical quality and market relevance of standards are directly influenced by the participation of entrepreneurs and innovators in standards development. Strong and sustained outreach to involve them and others (including government, consumers, and subject matter experts) is crucial to successfully accelerating new advances into the marketplace. By calling on a collection of experts and leveraging existing relationships (e.g., universities), SDOs committed to World Trade Organization standards-development principles – including openness and transparency – can bring a diverse array of key stakeholders to the planning table.



Leveraging the Strengths of SDOs

The need for closer coordination between standards developers and innovation-focused initiatives is growing as global competition increases. The standards development community brings a number of key advantages to these potential partnerships:

Speed.

International standards continue to evolve with the pace of technology and the needs of society. SDOs like ASTM International are incorporating collaborative tools such as real-time online meetings of technical committees and a seamless digital path from inception of concept to final deliverable to keep pace with ever-quickening product and innovation cycles.

Collaborative Expertise.

Increasingly, SDOs recognize the importance of partnering not only with leading trade groups and associations but also with each other. This collaboration provides jointly focused expertise and resources while also reducing duplication of effort.

Agility.

As new innovations come to market, SDOs have become nimbler in their ability to support the introduction of proposed standards while also accommodating revisions to existing standards. This level of agility is crucial in responding to emerging hazards and consumer safety issues and can significantly benefit the efficiency of advanced manufacturing research and development (R&D) activities (e.g., improving standard quality and facilitating access and validation via robust, repeatable, and reproducible analysis).

Enhanced Service Offerings.

Some SDOs also offer tools and resources beyond standards to meet the expanding needs of innovators. ASTM International, for example, offers training, proficiency testing, certification, peer-reviewed journals, symposia, and other resources, that help grow the awareness and knowledge needed for efficient standards implementation.

Additionally, as standards serve at the interfaces between previously separate fields of science and technology, collaboration with the standards community can lead to transformative tools including scientific instruments, analytical methodologies, and new materials and systems. Such standardized tools will allow the community to more rapidly and effectively integrate characteristics of materials, devices, and systems to understand the relationships or dependencies between manufacturing processes and performance.

Overall, SDOs such as ASTM International are more focused than ever on introducing high-quality, relevant standards into the marketplace as quickly as possible and are well positioned to support the key objectives of a diverse collection of major global innovation-driven efforts.

Conclusion

Innovation needs consensus standards as foundational elements and enablers of acceptability, the conduit between research and market. And, through SDOs such as ASTM International, the voluntary consensus standards system is a proven, valuable resource that can provide that necessary process infrastructure and support. The innovation and standards development communities must continue to partner on developing both standards and technology roadmaps in concert to ensure a clear strategy for enabling manufacturing innovation and accelerating commercialization.

Case Study: America Makes

America Makes, the first Manufacturing USA institute, was organized and is managed by the National Center for Defense Manufacturing and Machining (NCDMM), which creates manufacturing solutions to enhance U.S. defense systems. In 2013, ASTM International and America Makes signed a Memorandum of Understanding (MOU), building on ASTM's leadership in developing standards in additive manufacturing (AM).

Today, the institute's goal is to transition AM technologies into mainstream U.S. manufacturing, transforming traditional processes to meet industry needs while increasing domestic manufacturing competitiveness. To that end, America Makes collaborates with ASTM, providing technical expertise to help create groundbreaking AM standards. The MOU creates strong ties among entrepreneurs, companies, researchers, and the standards community, ensuring more efficient and effective standards development to help transition more AM technologies to the marketplace.

As a result of the MOU, ASTM International has launched a variety of new standards development efforts. For example, researchers from Case Western Reserve University have begun work, through ASTM International Committee F42 on Additive Manufacturing Technologies, on guidelines to extend mechanical-testing standards for metal products to products made via AM (Guide for Orientation and Location Dependence Mechanical Properties for Metal Additive Manufacturing).

Additionally, in 2016, America Makes, in partnership with the American National Standards Institute (ANSI), launched the Additive Manufacturing Standards Collaborative (AMSC), a cross-sector coordinating body whose objective is to accelerate the development of industry-wide AM standards to facilitate AM industry growth. In February 2017, the AMSC published an AM standards roadmap, which identifies both existing and in-development standards and specifications, assesses gaps, and makes recommendations for priority areas that require additional standardization. The roadmap is also supplemented by a list of standards that are directly or peripherally related to the issues described in the roadmap.

In support of the AM standards roadmap, and in recognition of the global nature of the AM market, ASTM and the International Organization for Standardization (ISO) have signed a Partner Standards Developing Organization (PSDO) agreement that enables, if desired, the creation of joint ISO/ASTM standards, developed by members of Committee F42 and TC261 on Additive Manufacturing. This model has been extremely effective in eliminating the duplication of standards effort that has complicated other industry sectors.

These efforts will continue to mature as AM technologies evolve. Moreover, this partnership illustrates how collaboration between the standards and innovation communities fosters the flexibility and responsiveness necessary to facilitate growth in emerging technology areas.