Impact of Standards on AI and Manufacturing

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• Federal agency within U.S. Department of Commerce
  Two main campuses: Gaithersburg, MD [HQ]
  Boulder, CO

• National Metrology Institute for the United States

• NIST Mission:
  Promote U.S. innovation and industrial competitiveness by advancing
  measurement science, standards, and technology in ways that enhance economic
  security and improve our quality of life
NIST Partnership with U.S. Manufacturers
for more than a Century

NIST helps the nation’s manufacturers to invent, innovate, and create through:

• **Measurement science** – manufacturers and technology providers use NIST test methods, measurement tools, performance measures, and scientific data every day

• **Advanced materials** – NIST is building a materials infrastructure to accelerate the timeline from design to deployment of new materials

• **Standards development** – NIST provides the scientific and technical basis for many voluntary consensus standards

• **Partnerships** – collaborations with the private sector and academic organizations help advance and disseminate research and support U.S. manufacturers

“It is therefore the unanimous opinion of our committee that no more essential aid could be given to manufacturing [...] than by the establishment of the [National Bureau of Standards].”
U.S. Congress committee, May 1900
Industry, Government, and Consumers Rely on Standards

• Standards can be used for (among others):
  • specifying requirements
  • communicating guidance and best practices
  • defining test methods and protocols
  • documenting technical data
  • accelerating adoption of new technologies
  • enabling trade in global markets
  • ensuring human health and safety

• Government regulatory agencies and certifying bodies may reference publicly available standards in their regulations and procedures

• Standards development in the U.S. is conducted through voluntary participation and consensus
NIST Influences on Manufacturing Standards

• Identification of consensus needs and priorities for standards
  • Workshops, industry meetings, outreach events, etc.

• Measurement science research to develop technical basis for standards
  • Draft content / starting point for development of documentary standards

• Service on standards committees
  • Leadership roles
  • Technical standards development
  • Strategic planning / big picture view

• Support the coordination, facilitation, and communication among a wide variety of standards groups
Standards Coordination is Important!

**Example: Standards Bodies Relevant to Additive Manufacturing**
- ASTM Committee F42 on Additive Manufacturing Technologies
- ISO Technical Committee 261 on Additive Manufacturing
- SAE Aerospace Material Specifications for Additive Manufacturing (AMS-AM)
- ASME Y14.46 on Geometric Dimensioning & Tolerancing (GD&T) Requirements for Additive Manufacturing
- ASME B46 Project 53, Surface Finish for Additive Manufacturing
- AWS D20 on Additive Manufacturing
- ISO TC184 / SC4, Product Data Representation for Additive Manufacturing
- <others – the **Standards Landscape continues to grow!**>
AI and Manufacturing

• **NIST strategic priorities:** Advanced Manufacturing, Artificial Intelligence, Cybersecurity, Quantum Science, Bio-economy, Internet of Things, and Infrastructure Resilience

• Application of AI to manufacturing is a significant focus of our research

  Characteristics of Manufacturing Data:
  • Data-rich but knowledge-sparse, many times with limited scientific understanding
  • Advanced tools needed to process complex and incomplete data
  • Publicly-available data sets and trained AI systems are needed

• **NIST Role in AI:** Promote innovation and develop public trust and confidence in systems that use AI
  • As AI technology advances, rigorous scientific testing is needed to ensure it is secure, trustworthy, and safe
  • Broad spectrum of standards needed for AI data, performance, interoperability, usability, security, and privacy
NIST Measurement Science Research: Examples of AI Impacts on Manufacturing

**Manufacturing Robotics**
AI enables improved **robot agility and rapid re-tasking** to learn new tasks, to respond to changes or errors, and to better perform existing tasks
- Impacts: More productive, more autonomous, and more flexible robots; Increased value to manufacturer

**Materials for Manufacturing**
AI is poised to revolutionize materials informatics for **new materials discovery** for manufacturing products and systems
- Impacts: New materials and material coatings: better, faster, cheaper; Improved product performance; Greatly reduces time-consuming trial-and-error; Faster time to market

**Additive Manufacturing**
AI provides new capabilities to optimize **manufacturing process parameters** to achieve desired part properties and performance
- Impacts: Improved products; Less rework; More accurate and reliable manufacturing process

**Industrial Internet of Things**
AI drives operational improvements and efficiencies for the **manufacturing factory floor**
- Impacts: Cost savings; Improved decision support and process execution; Customizable products; Optimized factory design and work flow
AI Standards Development

• While some AI-specific standards exist or are in development (e.g., ISO/IEC, IEEE, ASTM, OMG), many standards needs remain

• NIST Draft Plan for Federal Engagement in AI Standards Development
  • Resulted from NIST call for information and public workshop (May 2019); helpful contributions from many stakeholders; final plan due in August
  • Contains listing of current AI-related standards and development efforts, along with standards needs in multiple categories: data, metrics, safety, trustworthiness, networking, performance testing, etc.
  • Highlights the standards-related tools that are needed, including standard formats for data sets, test beds, and quantifiable measures to characterize AI technologies.
  • Recommended actions:
    • Bolster AI standards-related knowledge, leadership, and coordination among federal agencies
    • Promote focused research on the “trustworthiness” of AI
    • Support and expand public-private partnerships
    • Engage with international parties

Conclusion

• This is an exciting time for AI, at NIST and elsewhere! Advancements in AI have already led to many successes in the field of advanced manufacturing.

• Standards are essential to spur innovation and broad dissemination of new technologies

• NIST supports and influences standards development through measurement science research and service on standards committees. Some NIST motivations:
  • High quality, technically accurate standards
  • Usable and high impact standards that meet stakeholder needs
  • Integrated and cohesive set of standards: consistent, non-contradictory, non-overlapping
  • No duplication of effort / build upon existing standards

• Coordination, communication, and cooperation are essential to achieve this vision and to drive consensus standards that enable trade in global markets
  • End users, standards bodies, vendors, technology providers, regulatory agencies, etc. all play a role
  • Challenges continue to grow due to technology advancements and rapidly-changing environment

• Your feedback is encouraged on the NIST Draft Plan for AI Standards Development