

Impact of Standards on AI and Manufacturing

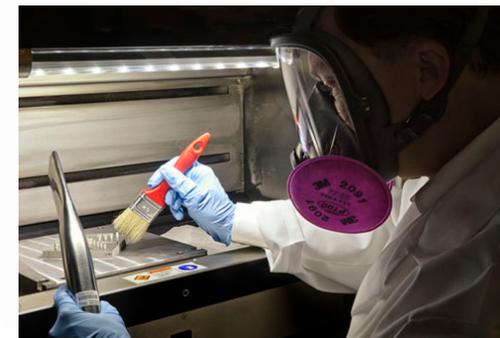
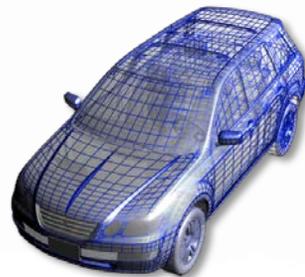
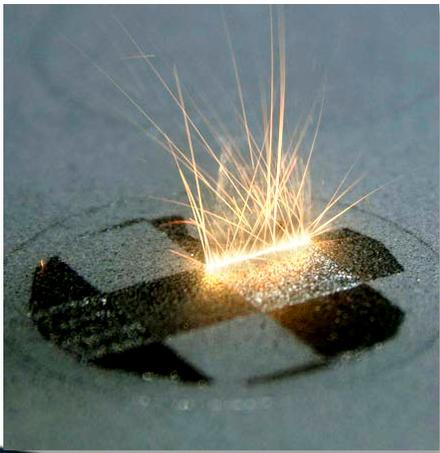


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(NIST)



National Institute of Standards and Technology (NIST)

- 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

“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

Infrastructural
Metrology

Uncompromising
Technical
Excellence

Rigorous
Traceability

Neutral and
Unbiased

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



Measurements and Standards

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

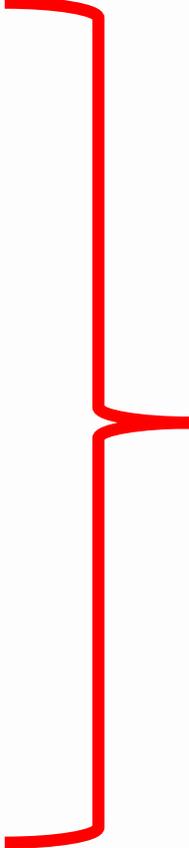
NIST Influences on Manufacturing Standards

- 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!**>



**NIST
Contributes to
All of These
Efforts**

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

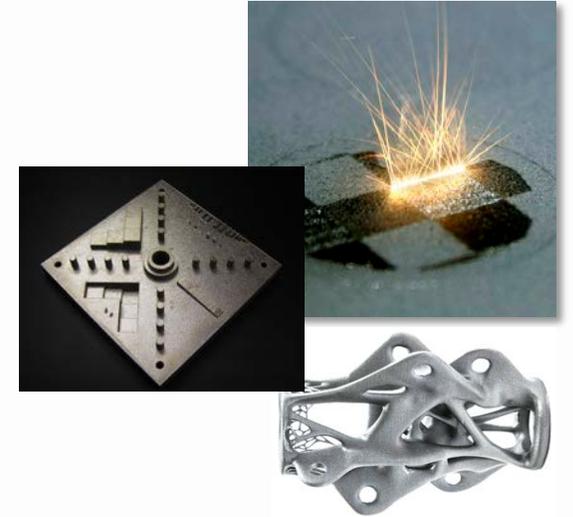
- Impacts: More productive, more autonomous, and more flexible robots; Increased value to manufacturer



Additive Manufacturing

AI provides new capabilities to optimize **manufacturing process parameters** to achieve desired part properties and performance

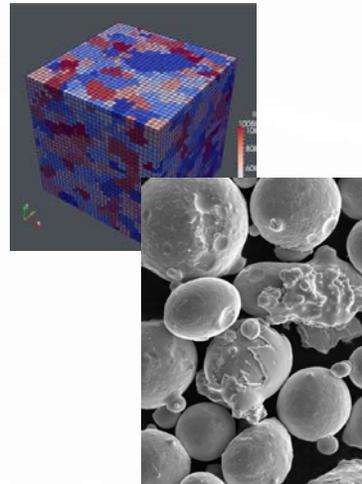
- Impacts: Improved products; Less rework; More accurate and reliable manufacturing process



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



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

Press release: <https://www.nist.gov/news-events/news/2019/07/nist-releases-draft-plan-federal-engagement-ai-standards-development>

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