



Smart Manufacturing and Standards: The NIST Role

Al Wavering, Chief
Intelligent Systems Division
Engineering Laboratory
National Institute of Standards and Technology
U.S. Department of Commerce

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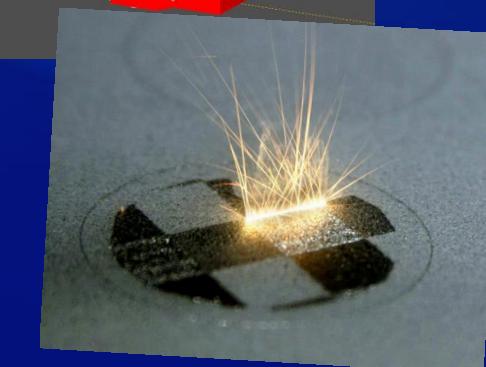
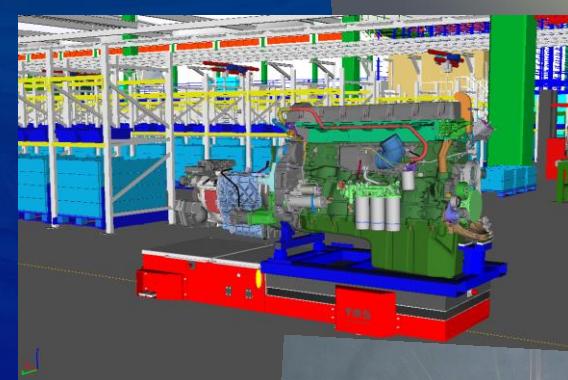
Manufacturing Drivers/Challenges

- Demand for Manufacturing Products
 - Customer demand for product variety and smart products
 - Customer demand for faster response to needs
 - Growing importance of global markets
 - Societal and economic pressure to increase sustainability
- Pressures on Industry
 - Challenges in maintaining pace with and integrating technology
 - Increasing need for asset and resource efficiency
 - Growing reliance on global supply chain and need for robustness and tracking
 - Increasing challenges to integrate with supply chain
 - Increasing security risks
 - Shorter product cycles – agility
 - Importance of value-added services throughout the product life-cycle
- Changing Workforce Skills
 - Growing scarcity of technical manufacturing talent



Technology Trends

- Digital Technologies
 - Internet of Things/Ubiquitous Sensing
 - Big data & advanced analytics
 - Cloud computing
 - Broadband communications, wireless
 - Mobile computing/apps
 - Security technologies
- Advanced Manufacturing Capabilities
 - Advances in additive processes/3D printing
 - Advances in robotics
 - Digital model-based everything
 - Complex systems engineering
 - Advances in materials



Smart Manufacturing: Synthesizing technologies to meet the challenges

Smart Manufacturing: the synthesis of advanced manufacturing capabilities and digital technologies to collaborate and create highly customizable products faster, cheaper, better, and greener

The NIST Contribution:

Measurement science and standards to drive innovation and reduce risks of adoption of Smart Manufacturing technologies



NIST Measurement Science Products

- Performance metrics, measurement and testing methods, predictive modeling and simulation tools, knowledge modeling, protocols, technical data, and reference materials and artifacts:
 - For **performance assessment and integration** of technologies, systems, and practices, including uncertainty analysis
 - Providing the **technical basis for standards** and practices—in many instances via testbeds, consortia, standards development organizations, and/or other partnerships with industry and academia



Smart Manufacturing Standards Areas

Driving Innovation and Reducing Risks of
Technology Adoption

**System
Design and
Analysis**



**Robotic
Systems**



**Operations
Planning
and Control**



**Additive
Manufacturing**



Smart Manufacturing Systems Design and Analysis

Delivering measurement science, standards, and tools needed to design and analyze smart manufacturing systems

- Service Oriented Architectures for Smart Manufacturing
- Modeling Methodology for Smart Manufacturing Systems
- Operations-driven Performance Measurement
- Data Analytics for Smart Manufacturing Systems



Smart Manufacturing Operations Planning and Control

Enabling performance, quality, interoperability, and cybersecurity standards for real-time monitoring, control, and optimization of assembly-centric smart manufacturing systems

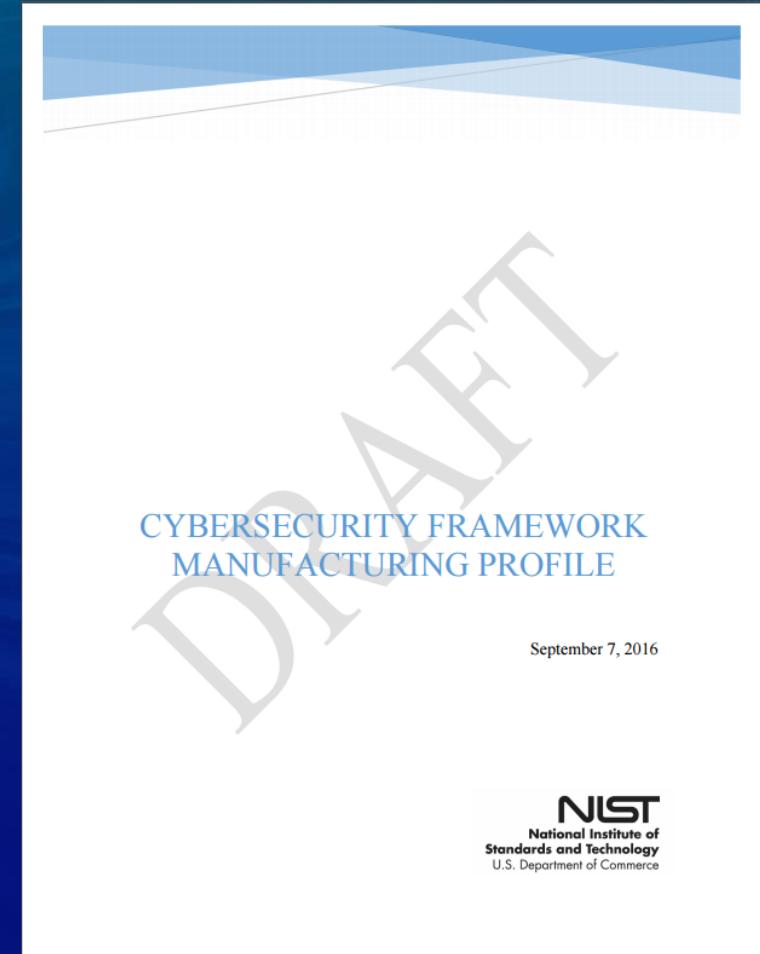
- Prognostics, Health Management, and Control
- Wireless Platforms for Smart Manufacturing
- Cybersecurity for Smart Manufacturing Systems
- Extending the Digital Thread for Smart Manufacturing
- Systems Analysis Integration for Smart Manufacturing Operations



NIST Cybersecurity Framework – Manufacturing Profile

- Draft manufacturing implementation, or Profile, of the NIST Cybersecurity Framework
- Establishes a roadmap for reducing cybersecurity risk for manufacturers, focusing on desired cybersecurity outcomes
- Provides a voluntary, risk-based approach for managing cybersecurity activities and reducing cyber risk to manufacturing systems
- Intended to enhance but not replace current cybersecurity standards and industry guidelines

Public comment period: September 7 – November 4, 2016
csrc.nist.gov/news_events/



Cybersecurity for Manufacturing Use Case Project

- Working with National Cybersecurity Center of Excellence (NCCoE) to develop a manufacturing use case project
- Purpose is to demonstrate that an advanced manufacturing infrastructure can be effectively monitored for and protected against cyber-attacks
- Behavioral Anomaly Detection, ICS Application Whitelisting, Malware Detection and Mitigation, and ICS Data Integrity capabilities will be demonstrated during the project

PROJECT DESCRIPTION

CYBERSECURITY FOR MANUFACTURING
Assessment of Capabilities for Securing Manufacturing Industrial Control Systems

Keith Stouffer
NIST Engineering Laboratory

Jim McCarthy
NIST National Cybersecurity Center of Excellence (NCCoE)

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Email address

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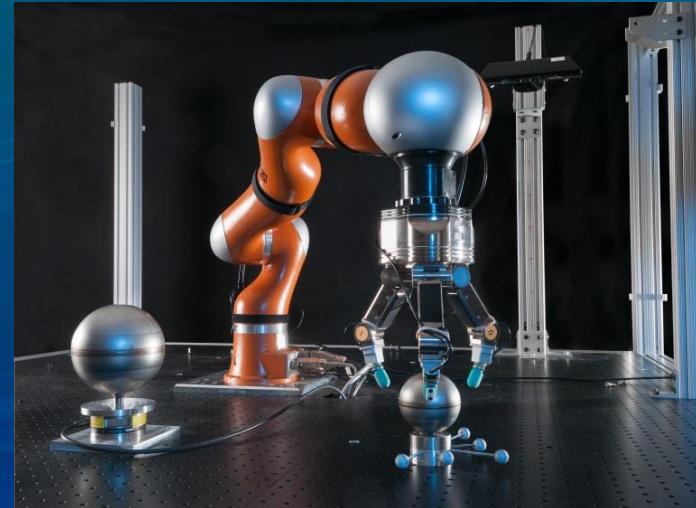
NCCoE
NATIONAL CYBERSECURITY
CENTER OF EXCELLENCE



Robotic Systems for Smart Manufacturing

Enabling improved robotic system performance, collaboration, agility, and ease of integration into the enterprise for assembly-centric manufacturing

- Performance Assessment Framework for Robotic Systems
- Performance of Collaborative Robotic Systems
- Agility Performance of Robotic Systems
- Robot Systems Integration for Smart Manufacturing
- Tools for Collaborative Robots within small and medium-sized enterprise (SME) Workcells



Measurement Science for Additive Manufacturing (AM)

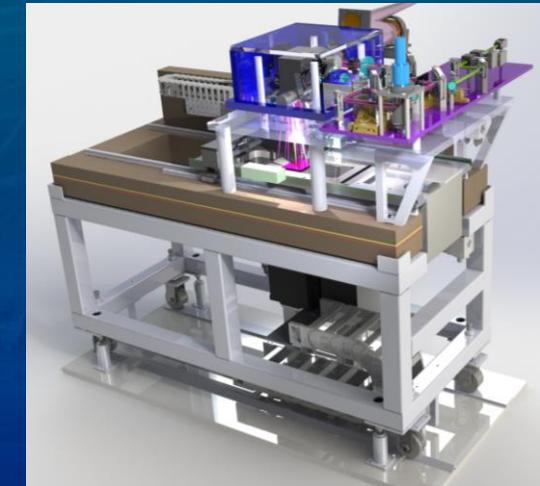


Objective

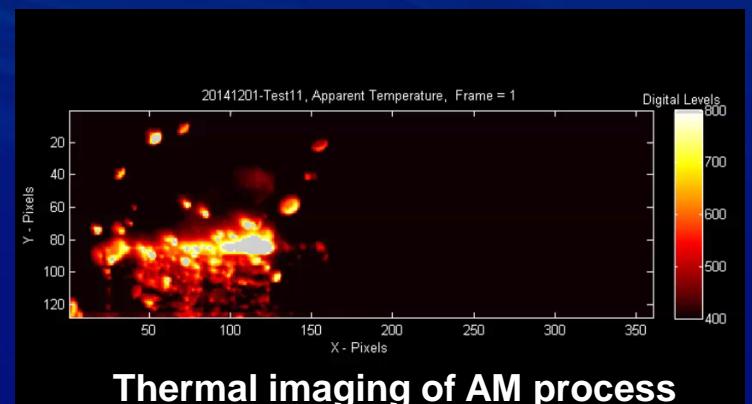
To develop and deploy measurement science that will enable metal Additive Manufacturing processes and systems.

Projects:

- Characterization of Additive Manufacturing Materials
- Real-Time Control of Additive Manufacturing Processes
- Qualification for Additive Manufacturing Materials, Processes, and Parts
- Systems Integration for Additive Manufacturing



NIST AM Metrology Testbed



Thermal imaging of AM process



Contact Information

Albert J. Wavering
Chief, Intelligent
Systems Division

301 975 3418
albert.wavering@nist.gov

NIST
100 Bureau Drive Stop 8230
Gaithersburg, MD 20899-8230

www.nist.gov/el/isd

