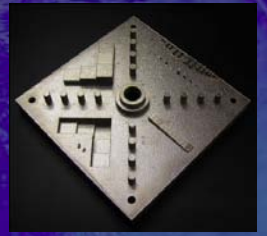


**Roadmapping Workshop:
Measurement Science for Metal-Based
Additive Manufacturing**

December 4-5, 2012 • National Institute of Standards and Technology • Gaithersburg, MD



**Report Out
December 5, 2012**

**Breakout Out Group:
Processes and Equipment**



Desired AM Capabilities/Technologies

- Improved in-situ sensors for manufacturing processes and equipment (real-time monitoring).
 - Better monitoring that enables real-time control of build environment (limit risk of contamination)
- Enhanced detection and use of materials to verify quality; validation of models/software
 - More sophisticated data collection via monitoring, sensors; life-cycle info
- Database for use among AM community
 - Catalogue of built parts; ability to identify best processes based on desired parts
 - Life-cycle knowledge (machines and parts)
- IP protection, anti-piracy, anti-counterfeit, and safety/security addressed
 - Embedded ID
- Use of multiple materials in the same AM part; new classes of AM
 - Improved characterization of parts and materials
- Ability to build microfeatures



Desired AM Capabilities/Technologies

- Cost-effectiveness and standardization of production at small- and large-scale operations
- Prevalence of certified products
- Part “signatures” to allow for traceability, life-cycle data collection
- Significant presence of AM production and manufacturing in U.S.
- Predictable, reliable, repeatable, affordable output in small lots and in high-speed continuous production
- Continued emphasis on advancing the field



Top-Voted Challenges/Priority Topics

- Sensors/controls (14 votes)
- Easy-to-use modeling and design tools (13 votes)
- Development of capability database for AM technologies (12 votes)
- Design allowables databases (10 votes)
- Non-Destructive Evaluation (NDE) techniques are not optimized for (metals) AM (9 votes)



Cross-cutting Themes

- Discussion of sensors dominated, limited discussion on technologies themselves.
- Challenges focused on identifying high-end (industrial) issues differ from those facing consumers (polymers/plastics).
- Many ideas involved learning tools. Opportunities exist to incorporate IT. Limited IT expertise in group, so full range of opportunities may not be reflected in cards.
- Output-based vs process-based standards.



Surprises

- Discussion of sensors dominated
- Modeling issues were a prevalent theme.
- Maturity of technologies was not a prominent point of discussion, despite need to address this.
- Counterfeit parts and anti-piracy concerns were raised as potential issues in the next 5 years.