NIST Advanced Manufacturing Strategic Planning Study
Interview Guide for Additive Manufacturing

The National Institute of Standards and Technology (NIST) in the U.S. Department of Commerce has contracted with RTI International to conduct an economic analysis of standards, measurement, and general purpose technology needs that inhibit efficient development and adoption of advanced manufacturing in the United States.

The objectives of this critical strategic planning study are to

- identify current and emerging needs related to standards and measurement,
- estimate the economic impact of meeting these needs, and
- review public policy and investment options.

The study has a particular focus on 4 aspects of advanced manufacturing: (1) robotics and automation, (2) smart manufacturing processes, (3) 3D Printing (additive manufacturing), and (4) roll-to-roll manufacturing. The focus of our conversation is additive manufacturing technology.

Your perspective will help guide NIST's planning and investment process. Participation in this analysis is confidential; only aggregated information will be included in any deliverables or communications. Your name and your company's name will not be disclosed. We do not wish to discuss specific products, strategies, or technologies; but rather your thoughts about how investments in standards and measurement technologies would affect your company and companies like yours.

Our research products will be an economic analysis, final report, and presentation materials. All deliverables will be publicly available in late 2015 and these will be shared with you as soon as they are released.

If you have questions, please contact:

- Alan O'Connor, Principal Investigator, RTI, 919-541-8841 or oconnor@rti.org
- Gary Anderson, NIST Project Officer, NIST, 301-975-5238 or gary.anderson@nist.gov

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Respondent Contact Information

1. Name
2. Title
3. Division
4. Company
5. Telephone
6. Email
7. Location, if not USA

Respondent Background

8. Please give a brief description of your experience with additive manufacturing technology. How did you come to be in your current position?

9. How familiar are you with the National Institute of Standards and Technology?

About Your Company

10. How would you describe your primary line of business (i.e., industry classification)? What do you produce and sell most?

a) Approximately what percentage of your company's sales revenue is associated with your division, or the division for which you are responsible? A range is fine.

11. How does your company use additive manufacturing technology?

a) For what applications (e.g., for prototypes, tooling, or final products)? What factors make additive attractive for those applications? What factors limit additive to only those applications?
b) What types of additive manufacturing technology do you use? In terms of materials, methods?

12. As far as you are aware, is your division or company engaged with any industry consortia, standards organizations, or governing bodies specifically for additive manufacturing? If so, in which bodies do you participate and what are the underlying drivers for participation?

13. Generally, does your company conduct R&D related to the use of additive manufacturing technology? If so, what are the broad objectives of that R&D (e.g., cost reduction, quality improvement, other)?

Industry Needs

Several industry-level needs have been identified, and discussions with experts have suggested measurement and test methods, material and process standards, reference databases, and general purpose technologies that could meet these needs.

Industry Needs	Potential Impacts (examples)
Standards, best practices, and reference data for materials and AM processes	Improve confidence via reproducibility across manufacturing methods Greater assurance in raw materials
Real-time metrology – integrated sensors for real-time feedback during a build	Identify in-build defects in time to correct and continue the build or scrap before using additional material
Design optimization tools and protocols for complex builds	"Design to manufacture" guidance for designing and printing complex parts, including mesh, lightweight, and sacrificial support structures Reduce scrap rates and turnaround times, and improve reliability and reproducibility of parts
Process modeling and simulation for different materials and designs.	Improve yields, shorter and fewer R&D cycles Predict anomalies at various stages of a build Understand material-specific processes leading to new applications
Cost-effective approaches to improve surface finishing of metal AM parts, and standards for measuring surface finish and tolerances	Eliminate or greatly reduce the degree of post-processing required to make production-quality parts
Innovative mechanical testing procedures	Improve efficiency and cost savings from nondestructive and other test methods Confidence in AM processes and materials to speed up adoption and validation of high-value printed parts in various applications

14. Do any of these needs apply to your company's use of additive manufacturing technology? In other words, if one or more of these needs were to be met, would it benefit your company? If so, how?

15. If several needs were discussed in question 14 as being relevant to your company, could you prioritize them? Which are the most important?

16. Are there needs not included in the table that you would include? If so, what are they?

17. If these needs were all met today, how would that impact your company's R&D and production?

a) Changes in the types of additive manufacturing technology used? (materials/methods)
b) Changes in the range of applications of additive manufacturing technology?
c) Others?

18. Can you describe any types of impacts on your company if these needs were met, in terms of costs of production? A range is fine.

a) Time required to test/validate raw materials?
   (+ / – by roughly what %? _____%)
b) Cost to test/validate raw materials?
   (+ / – by roughly what %? _____%)
c) Time required to reach first successful build?
   (+ / – by roughly what %? _____%)
d) Cost required to reach first successful build?
   (+ / – by roughly what %? _____%)
e) Scrap rate and number of defects?
   (+ / – by roughly what %? _____%)
f) Others?
   (+ / – by roughly what %? _____%)

19. To enable us to combine your responses with the responses of others and provide NIST with a sense of potential impacts at the industry level, could you quantify the impacts we have discussed in terms of the following metrics? A range is fine.

a) Cost of materials + / – _____%
b) Cost of energy/electricity + / – _____%
c) Cost of labor + / – _____%
d) Cost of capital equipment + / – _____%
e) Overall cost of production + / – _____%

20. Would you say that your answer to question 19 is representative of your industry (of companies in similar lines of business), or of only a subset? Please explain briefly how, if at all, the anticipated impacts for your company may be different from the industry as a whole, or how different industry segments may be affected differently.

21. Switching from thinking about costs to thinking about your company's product offering, could you briefly describe what changes could be expected if these needs were all met today?

a) Changes in the quality of existing products?

b) Changes in the amount of customization within existing product lines?
c) Introduction of new products or product lines?
d) Others?

22. To enable us to combine your responses with the responses of others and provide NIST with a sense of potential impacts at the industry level, could you quantify these impacts in terms of a relative change in your company's sales? A range is fine. + / – _____%

23. Would you say that your answer to question 22 is representative of your industry (of companies in similar lines of business), or of only a subset? Please explain briefly how, if at all, the anticipated impacts for your company may be different from the industry as a whole, or how different industry segments may be differently impacted.

24. Would you expect any changes in your company's investment patterns or risk tolerance, if the needs discussed above were met? If so, what types of changes?

25. Are there any additional comments you would like to share?

We Greatly Appreciate Your Time and Input.