

## **NIST Advanced Manufacturing Strategic Planning Study Interview Guide for Roll-to-Roll Manufacturing Users**

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 roll-to-roll manufacturing.

Your perspective will help guide NIST's investment planning. NIST relies on confidential feedback from industry to set priorities and the business case for investment in the technology base supporting U.S. manufacturing.

Participation in this analysis is confidential; only aggregated information will be included in any deliverables or communications. Your name or your company's name will not be disclosed. We do not wish to discuss specific products, strategies, or technologies. Rather, the focus is on your thoughts about how investments in standards and measurement technologies might affect your company and companies like yours.

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

If you have questions, please contact:

- Alan O'Connor, Principal Investigator, RTI, 919-541-8841 or [occonnor@rti.org](mailto:occonnor@rti.org)
- Gary Anderson, Project Officer, NIST, 301-975-5238 or [gary.anderson@nist.gov](mailto:gary.anderson@nist.gov)

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Technology, Attn., Gary Anderson, gary.anderson@nist.gov, (301) 975-5238. The OMB Control Number is 0693-0033, with an expiration date of 03/31/2016.

### **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 in roll-to-roll (R2R) manufacturing. 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 (e.g., industry classification)? What do you produce and sell the most?
  - a. What types of products does your firm produce using R2R methods?
  - b. Did your firm develop a unique R2R manufacturing system?
  
11. Approximately what percentage of your company's sales revenue is associated with your R2R-related operations? A range is fine.
  
12. As far as you are aware, is your division or company engaged with any industry consortia, standards organizations, or governing bodies for R2R manufacturing or other products that use R2R manufacturing? If so, in which bodies do you participate and what are the underlying drivers for that participation?
  
13. Generally, does your company conduct R&D related in R2R manufacturing methods? If so, what are the broad objectives of that R&D (e.g., cost reduction, quality improvement, other)?

## Industry-Level Needs

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

Areas of Infrastructure Need	Infrastructure Technology to Help Meet Needs
Input materials, including inks and substrates	<ul style="list-style-type: none"> <li>• Reference materials and quality standards</li> <li>• Standard protocols and best practices to improve repeatability and materials quality validation</li> </ul>
New materials and substrates	<ul style="list-style-type: none"> <li>• New materials formulations, especially for high-conductivity or high temperature applications</li> <li>• New substrates that maintain structural and adhesive properties when bent or folded</li> </ul>
Metrology for tooling and feedback	<ul style="list-style-type: none"> <li>• Advanced tools and sensors to use with moving, reflective, and/or optically transparent web</li> <li>• High resolution metrology</li> <li>• Large area metrology</li> <li>•</li> </ul>
Alignment on a moving substrate	<ul style="list-style-type: none"> <li>• Tools to enable high throughput alignment, thus avoiding faulty production runs</li> </ul>
Process modeling and controls	<ul style="list-style-type: none"> <li>• Process control (move to closed-loop, develop and integrate sensors)</li> <li>• Automated design flows</li> <li>• Process simulation tools</li> </ul>
Consistent terminology for standards and nomenclature	<ul style="list-style-type: none"> <li>• International standard definitions and measurements for processes and materials</li> <li>• Agreed-upon nomenclature</li> </ul>
Patterning Methods	<ul style="list-style-type: none"> <li>• Tooling for seam-free fabrication, including cylindrical masters at nanoscale fidelity</li> <li>• Optical and evaporative methodologies for creating patterns on moving web</li> </ul>
Integration and Packaging	<ul style="list-style-type: none"> <li>• New materials and methods for packaging that are compatible with continuous R2R production</li> </ul>

**14.** Are these needs relevant to your company? If one or more of these needs were to be solved, how would it benefit your company?

**15.** How would you prioritize the areas in terms of those that are most/least important to your company?

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

17. Suppose that these needs were all met today. How would they impact your company's R&D and production?

18. Can you describe any types of impacts that meeting these needs would have in terms of the costs of production? Ranges are fine.

a. Changes in time needed to configure/test/validate materials, substrates, alignment, or tooling?

(+ / - by roughly what %? \_\_\_\_\_%)

b. Changes in the cost needed to configure/test/validate materials, substrates, alignment, or tooling?

(+ / - by roughly what %? \_\_\_\_\_%)

c. Changes in duration of product development to production cycle?

(+ / - by roughly what %? \_\_\_\_\_%)

d. Changes in the proportion of scrapped to successful production runs?

(+ / - by roughly what %? \_\_\_\_\_%)

e. Others?

(+ / - by roughly what %? \_\_\_\_\_%)

19. To enable use 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? Ranges are fine.

Cost of materials	+ / - _____%
Cost of energy/electricity	+ / - _____%
Cost of labor	+ / - _____%
Cost of capital equipment	+ / - _____%
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)? 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 the impacts from Question 21 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)? 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 types of technologies discussed above were made available? If so, what types of changes?
- 25.** Are there any additional comments you would like to share?

**We Greatly Appreciate Your Time and Input.**