

Technological Innovation, NIST, and the U.S. Measurement System

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You've heard from the Director of NIST of his view
of the importance of technological innovation to the U.S.

You've heard his vision of the mission of NIST
to support technological innovation and
advance the national infrastructure for innovation

You've heard about work at NIST under that vision
in nanotechnology, biotechnology, public safety and security

Now you're going to hear about NIST support of innovation
through its look at the nation's measurement system

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Introduction: The USMS

- The measurement system of the United States, the USMS, is extensive, complex, and non-hierarchical
- It includes every firm and individual in the U.S. that makes or uses measurements for an economic purpose
- It includes also every organization in the U.S. that supports the the making of valid measurements, including instrument manufacturers and vendors, calibration laboratories, standards developing organizations, and accreditation bodies
- Virtually everyone in the U.S. depends every day on the effective operation of the USMS
- For all that, nobody is in charge of the USMS

NIST and Its Assessment of the USMS

- NIST is the U.S.'s National Measurement Institute, responsible for realizing and providing access to the U.S. national standards of physical measurement, the units of the International System of Units, the SI
- Many people think that NIST, as such, should take a look to see whether the U.S.'s measurement system (USMS) is adequately meeting the nation's measurement needs
- NIST has been persuaded to make such an assessment
- To do so, the NIST Director has
 - created the NIST USMS Project
 - designated a Director reporting to him
 - established an objective for NIST to produce an assessment by June 2006

Logic of the NIST Look at the USMS

Technology is a foundation of the U.S.'s economy and defense

Innovation in technology is a major source of the nation's economic well-being and military strength

Technological innovation is a basis for increased competitiveness, productivity, and quality

Logic of the NIST Look at the USMS

Technological innovation is the
introduction into the marketplace of new technology

This new new technology can be either

product technology, i.e.

a product that incorporates new technology; or

process technology, i.e.

a production process that incorporates new technology

Logic of the NIST Look at the USMS

Most of U.S. industry's most critical needs in measurements are linked to technological innovation

These measurement needs arise from measurement problems associated with the creation, production, or marketing and effective use of new product and process technologies

It is a primary function of the U.S. measurement system to deliver measurements that meet U.S. industry's measurement needs

Logic of the NIST Look at the USMS

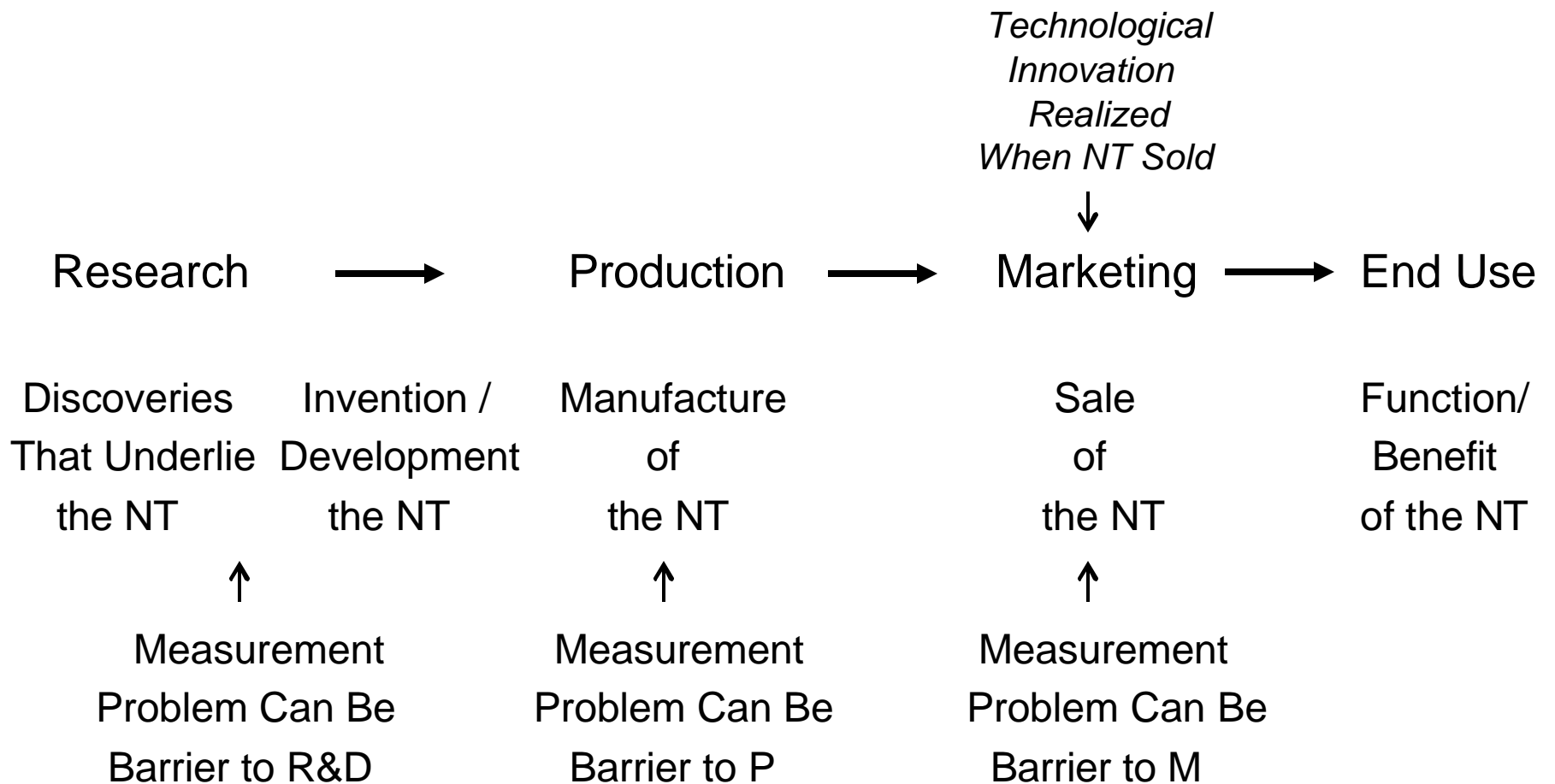
An assessment of the state of the USMS can well begin then
with a broad survey of industry measurement needs
relative to technological innovation

From the results of this survey, inferences may be drawn
about the overall state of health of the USMS
and an assessment made

And an action plan developed to address identified industry needs
and systemic problems with the USMS as a whole

Economic Model of Measurement Problems as Barriers to Technological Innovation

Technological Innovation = Introduction into Marketplace of New Technology
 Moved from Research through Production and Marketing to End Use



Examples of Measurement Barriers to Technological Innovation

- **Barrier at Marketing** An instrumentation company develops a digital multi-meter with linearity and precision that it believes, but cannot prove to customers, are far beyond anything else commercially available
- **Barrier at Mfg** Producers of integrated-circuit photomasks cannot reproducibly establish the widths of the new-generation features on the masks they are making because of mysterious discrepancies in measured widths
- **Barrier at Research** Developers of carbon-nanotube based materials are stymied in getting predictable results by inability to define the composition of the nanotube additive in terms of purity, count and distribution of lengths of nanotubes

The Method of the Assessment

- In collaboration with industry as a private-public partnership, identify measurement problems that pose technical barriers to technological innovation
- Carry out a broad survey of the space of measurement needs from multiple perspectives in parallel
- Use industry technology roadmaps, NIST-industry workshops, and other fact-finding techniques
- Compile collection of well-defined industry measurement needs linked to technological innovation
- Examine the collection of identified measurement needs for trends and commonalties
- Draw inferences about the state of the USMS as an element of the national infrastructure for innovation

Surveying the Space of Industry Measurement Needs

To achieve a broad survey of industry measurement needs,

the approach is to look at the overall space of measurement needs

from different perspectives, that is, from different bases,

at the same time in parallel

Sectors

- Semiconductors
Well-defined
Economically important
Measurement problems on road-mapped path
- Automotive
Well-defined
Economically and “culturally” important
Have entrée through USCAR, AIAG
- “Software” / IT
High visibility, economically important,
Technologically dynamic
Needs measurement underpinning

Technologies

- Broad / Emerging Any on industry's/NIST's radar
Wide-scope, "emerging" or
"national needs areas"
Nanotechnology
Medical-/Bio-Imaging
First Responder
- Discrete /Topical Any on industry's/ NIST's radar
Typical industry-needs workshop
USMS-branded, NIST, or other

SI Units

- International System of Units (SI) plays a special role in physical measurements and provides a well-defined basis for looking at the space of U.S. measurement needs
 - » Mass
 - » Length
 - » Time
 - » Electrical Quantities
 - » Temperature
 - » Amount of Substance
 - » Luminous Intensity

Disciplines

- Underlying the spectrum of physical technologies are scientific-engineering-technical disciplines

Physics/Applied-Physics

Chemistry/ChemE

Materials Sci&E

Electrical-Electronic Eng

Mechanical-Civil Eng

Computer /IT S&E

Manufacturing Eng

- NIST's organization reflects that underlying disciplinary structure and provides an operational basis for broad view of measurement needs from this perspective

The Datum of Input to the USMS Assessment - An Industry Measurement Need

Information	Technological innovation at stake Economic significance of the innovation Technical barrier to the innovation Stage of innovation at which technical barrier appears Measurement-problem part of the technical barrier Potential solutions to the measurement problem Potential providers of these solutions Government role, if any, in these solutions
Format	One page, crafted, with documented support

Output of NIST Look at the USMS

- In summer 2006 NIST will report the results of its needs-based assessment of the state of the USMS as an element of the national infrastructure for innovation, including
 - the specific industry measurement needs identified as posing technical barriers to innovation
 - an analysis of the trends and commonalties among those specific innovation-limiting measurement needs
 - its findings on the state of the USMS and any systemic problems identified
 - the follow-up actions it will take to achieve solutions to those measurement needs and systemic problems that it has identified

Intended Benefits of Assessment Report

- Allow potential providers of solutions to specific measurement problems to be engaged and mobilized
- Bring the attention of stakeholders to bear on systemic issues in the functioning of the U.S. measurement system as whole
- Serve as a catalyst for the identification of other industry needs and systemic problems of the USMS
- Overall contribute to getting the nation's innovation-limiting measurement needs addressed

Conclusion

- A key part of the national infrastructure that supports technological innovation is the nation's measurement system
- The U.S. measurement system is extensive and complex with no one in charge of it
- NIST, as the U.S.'s National Measurement Institute, has accepted the challenge of looking at the USMS to see how it is meeting the nation's measurement needs in the area of innovation
- We expect benefits to industry as a result of this effort
- We welcome your input to it