2003 Annual Report

THE NIST VISITING COMMITTEE ON ADVANCED TECHNOLOGY

U.S. DEPARTMENT OF COMMERCE
TECHNOLOGY ADMINISTRATION
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
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Preface

The Visiting Committee on Advanced Technology (VCAT) of the National Institute of Standards and Technology (NIST) was established in its present form by the Omnibus Trade and Competitiveness Act of 1988. The VCAT reviews and makes recommendations regarding general policy for the National Institute of Standards and Technology, its organization, its budget, and its programs, within the framework of applicable national policies as set forth by the President and the Congress. It submits an annual report to the Secretary of Commerce for submission to the Congress. This Fiscal Year 2003 annual report covers the December 2002 meeting through the September 2003 meeting.

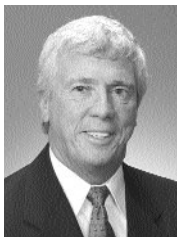
The Committee studies the allocation of resources employed to achieve NIST's mission as well as the policies and processes employed by NIST management to optimize the overall effectiveness of the Institute's programs. Over time, the Committee seeks to cover the full spectrum of activity at NIST. In addition to direct discussion with NIST leaders and professionals, the committee reviews reports from the National Research Council Board of Assessment (of the technical excellence of NIST's programs), the MEP Advisory Board, and the ATP Advisory Committee. In light of the broad experience represented by the VCAT and the other Boards, this approach delivers a reliable overview of NIST. Reactions and observations are discussed candidly with the NIST representatives involved at each meeting. This feedback is positively received, and we see much evidence of constructive response to it.

Members of the Committee are selected on the basis of their backgrounds and experience and are appointed by the NIST Director to staggered 3-year terms. Three new members joined the Committee during 2003, Mr. Scott C. Donnelly, Dr. Lou Ann Heimbrook, and Mr. Robert T. Williams.

2003 Visiting Committee Members

DR. JUAN M. SANCHEZ
VCAT Chair
Vice President for Research
University of Texas, Austin

MR. SCOTT C. DONNELLY
Senior Vice President
GE Corporate Research & Development
General Electric Company



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Bluefire Partners

DR. RICHARD M. GROSS
Corporate Vice President of Research and Development
The Dow Chemical Company

DEBORAH L. GRUBBE
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Technology Management Consultant

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3-Dimensional Pharmaceuticals, Inc.

DR. APRIL M. SCHWEIGHART
Product Business Manager
Motorola

ROBERT T. WILLIAMS
Director,
Manufacturing Operations Support & Technology
Caterpillar Inc.

I. Executive Summary

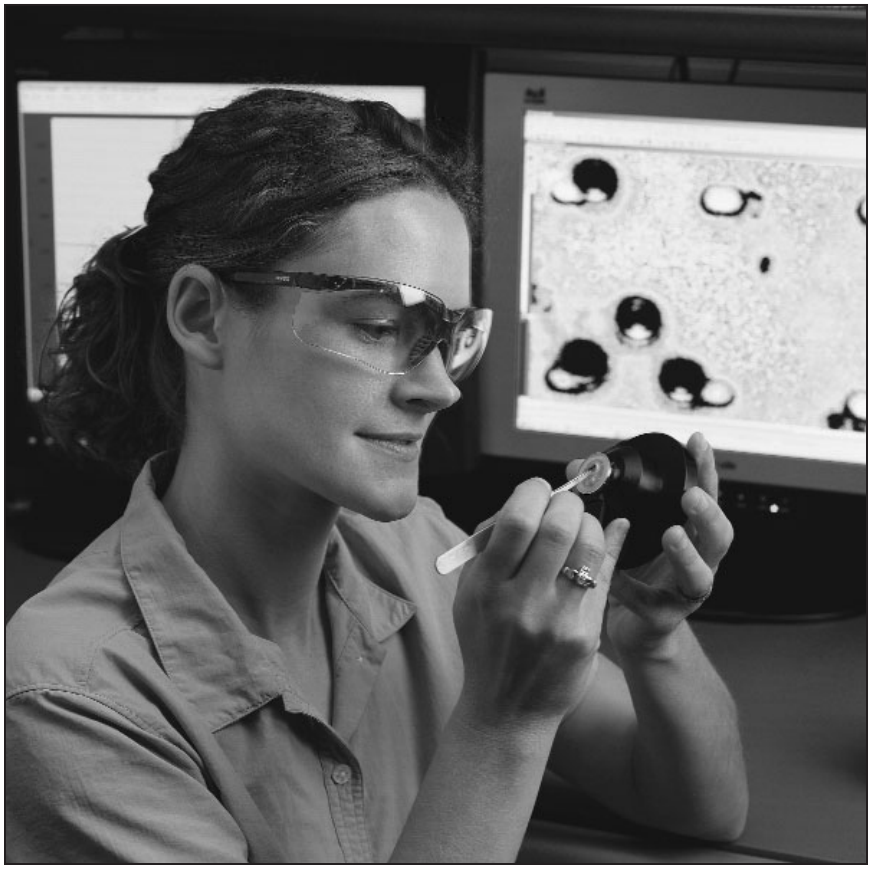
The NIST Visiting Committee on Advanced Technology (VCAT) reviews and makes recommendations regarding general policy for the National Institute of Standards and Technology (NIST), its organization, its budget, and its programs, within the framework of applicable national policies as set forth by the President and the Congress. We present these findings in this annual report to the Secretary of Commerce for submission to the Congress.

The VCAT continues to be impressed with the quality of the technical work at NIST. The results of NIST research provide real, tangible, benefits to the U.S. economy. NIST's mission and role, which focus on measurement and standards, are indispensable to maintaining and enhancing productivity and competitiveness; enabling international trade; and improving public health, safety, and environmental quality. Particularly noteworthy accomplishments this year are:

- The NIST 2010 Strategic Plan is becoming central to the leadership and operations of NIST. This is a high-value activity that will give NIST a good sense of where it needs to go and the resources required. Over the past two years NIST has moved from the development of a framework to actual implementation of the Plan, has aligned its research strategies with the Plan goals, and is beginning to develop a set of goals that cascade down through the OU operating plans. The Committee is highly impressed with the progress that NIST has made, and now that NIST is over this initial hurdle, expects progress to accelerate rapidly.

- NIST's reaffirmation of its commitment to its traditional measurement and science mission and its leadership of a National Measurement System (NMS), is an important strategic decision. NMS leadership is a challenging role that is likely to produce significant economic benefit, if NIST and other organizations collaborate to promote an efficient, possibly global, non-redundant, measurement infrastructure.

- NIST has increased its emphasis on performance metrics and accountability. NIST is making progress on a NIST-wide balanced scorecard that includes two or three metrics in each of the five main areas of management priorities.



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In one of many nanotechnology projects, NIST scientists are fabricating magnetic traps to improve manipulation and analysis of single strands of DNA or RNA.

Several of the metrics are currently included in OU Director performance plans.

- NIST has made good progress during the past year in developing external partnerships, particularly notable is the joint Postdoc program with NIH. This approach will increase the leverage of taxpayer investment at both institutions through using the special competencies of each. This collaborative model could be useful in other areas.

The VCAT views these developments as highly positive, and encourages NIST to continue and extend these practices to become even more flexible to meet emerging opportunities. The VCAT offers the following complementary comments and recommendations for enhanced effectiveness and further progress.

- The NIST 2010 Strategic Plan provides an excellent vehicle for NIST to better articulate its commitment to continue to provide significant economic benefit to the U.S. economy. The next revision of the Plan should identify clear and reasonably direct economic benefits for each of the Plan's major elements.

- In order to make effective a National Measurement System, NIST must define the overall goals for the NMS. Then NIST must identify its distinctive competencies, articulate why NIST should lead the effort, and gain support from involved external entities.

- In order to move the organization to the next level of performance, it is essential that the Strategic Plan be reflected as quickly as possible in the operating plans and in real-time program decisions. More detail is needed on the linkage of specific research programs to higher-level plan goals, consistent with customer needs. NIST must continue the process it has started--to continue developing a method for managing resources on a NIST-wide basis.

- NIST's leadership's increased emphasis on safety is appreciated. However given the importance of safety, the staff must become involved in actively reducing the reportable injury rates.

These and related points are discussed in more detail in Section II. Section III summarizes and consolidates the information from NIST presentations to the Committee. Further details can be found on the VCAT web site: http://www.nist.gov/director/vcat/.

II. Discussion of Key Issues

The VCAT continues to be impressed with the quality of the technical work at NIST. The results of NIST research provide real, tangible, benefits to the U.S. economy. NIST's mission and role, which focus on measurement and standards, is indispensable to maintaining and enhancing productivity and competitiveness; enabling international trade; and improving public health, safety, and environmental quality.

The Committee was pleased to see significant organizational changes this year intended to increase the effectiveness in a changing environment. The announced changes in the senior management team are supported by the Committee and these changes give NIST management the opportunity to prioritize the issues affecting the organization and develop effective areas of responsibility. Continuing efforts to include broad participation of the Operating Unit Directors in a NIST-wide planning process are necessary to identify the types of multi-disciplinary research projects that will be needed in the future. Reinvigorating the concept of a National Measurement System will help sharpen strategic thinking and is a powerful method to help identify appropriate new research topics for NIST.

Given the recognized overall technical excellence of NIST, however, the Committee can best provide value to NIST and its stakeholders by focusing on areas where NIST can improve. Issues and recommendations that the Committee views as important to NIST were discussed thoroughly at the quarterly meetings, and the results of those discussions are presented in this section.

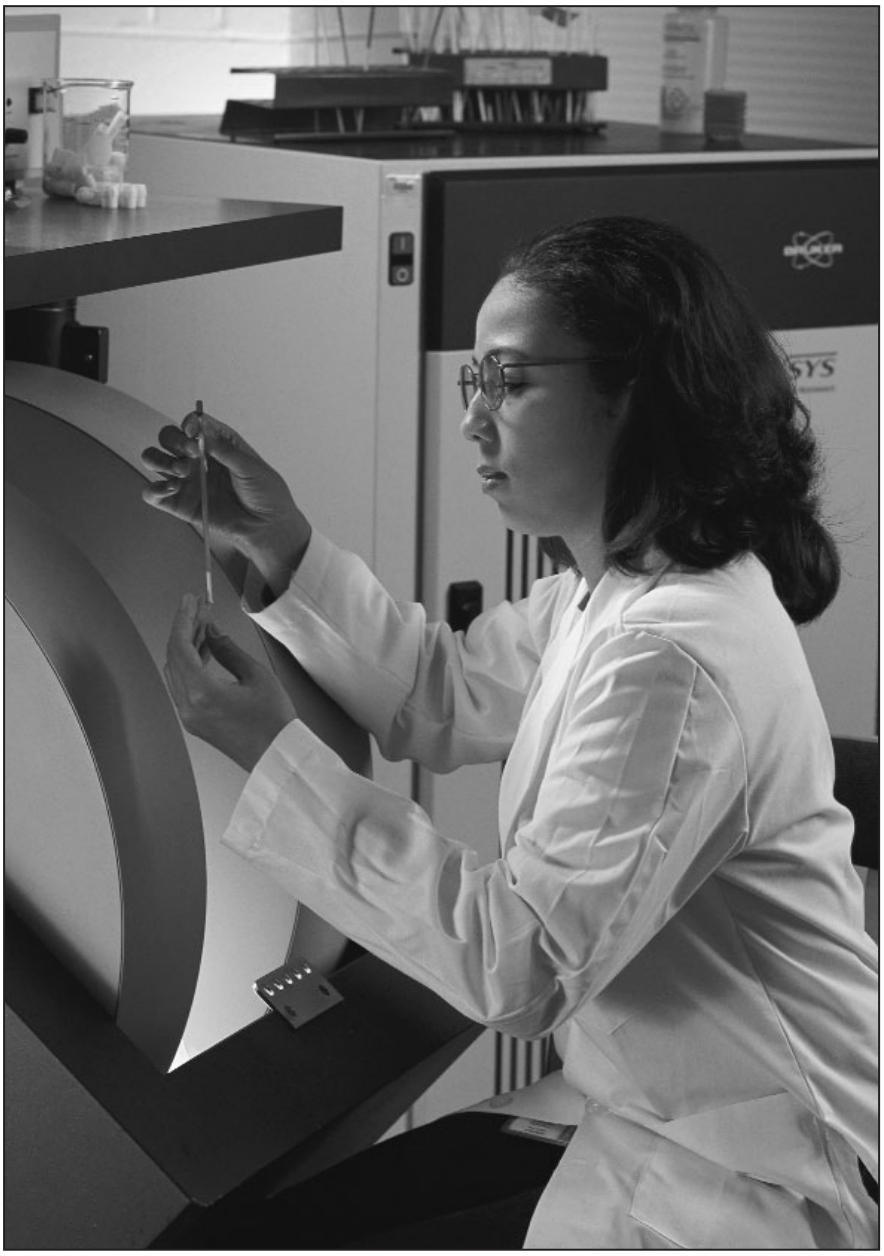
A. NIST 2010 Strategic Plan

The Committee has reviewed the NIST 2010 Strategic Plan during its development process over the past two years and finds that the Plan is an effective mechanism for charting NIST's future. It is an excellent sign that NIST management has instituted a process in which they continuously examine the Plan for inadequacies and that they have set up processes to correct those inadequacies. Over the past two years, NIST has moved from the development of a framework to actual implementation of the Plan, has aligned its research strategies with the Plan goals, and is beginning to develop a set of goals that cascade down through the OU operating plans. The Committee is highly impressed with the progress that NIST has made, and now that NIST is over this initial hurdle, expects progress to accelerate rapidly. Because of the importance the Committee attaches to the evolution of the Plan and its implementation, it has focused most of its attention on those issues this year.

NIST's programmatic Strategic Focus Areas are in good alignment with the Administration's present R&D budget priorities. But, part of a long term strategy is to be prepared to support technological change. NIST has strongly demonstrated the capability to rapidly organize its resources to meet national needs in homeland security technologies, in part, because of its broad base of fundamental measurement competencies. An effective strategic plan needs to have the flexibility to go beyond explicitly defined focus areas. Thus, the Committee supports reaffirming NISTs commitment to its traditional measurement and science mission through leadership of a National Measurement System (NMS). NIST may understand the NMS but it needs to strongly and broadly communicate the benefits of an NMS to identified constituencies. It is not possible for NIST to carry out all the necessary processes of an NMS, but it should be the holder of the processes, with the work done in cooperation with other agencies, and other national measurement bodies. NIST must define the overall goals of an NMS, identify its distinctive competencies, articulate why NIST should lead the effort, and gain support from involved external entities.

Plan implementation

It is evident that the NIST 2010 Strategic Plan is a living process and is becoming central to the leadership and operations of NIST.



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Determining the radiation exposure of an amino acid sample as part of a project to help ensure effective sterilization of U.S. government mail.

This is a high-value activity that will give NIST a good sense of where it needs to go and the resources required. NIST is gradually adjusting its work portfolio and competencies to conform to the strategic plan. However, it is essential that the Plan continue to be implemented as quickly as possible to move the organization to the next level of performance.

Given the current environment and budget situation, NIST management has decided to focus first on implementing two of the four programmatic Strategic Focus Areas (SFAs), Nanotechnology and Homeland Security. This narrowed focus is appropriate.

Implementation of the nanotechnology SFA is being accomplished at the Operating Unit (OU) level. Two roles have been identified: measurements and standards, and critically evaluated data. The OUs expect a 50% increase (FY2002 to FY2004) in nanotechnology related research funding as a result of reprogramming within the OUs. During FY2003, the OUs have been characterizing their present portfolio of projects, and through resource reallocation move them to be more consistent with the strategic plan. The next steps are to establish an on-going customer focus.

NIST has the technical capabilities to contribute strongly to measurements and standards for homeland security. Of the total funding in FY2002 applied to homeland security, approximately 70% was derived from reprogramming from other projects. In many cases the "reprogramming" effort was accomplished by leveraging

ongoing work, but sharpening and shifting its focus to apply to homeland security. NIST has the opportunity to work with the Department of Homeland Security and other federal laboratories, and should continue to press for a collaborative role in facilitating measurements and standards.

Performance metrics

Developing and using appropriate performance measures are essential to demonstrate that NIST is a high-value organization providing focused, effective results. These may be considered to fall into two categories: (1) measures for external publication to demonstrate the effectiveness and value of NIST work to the U.S. economy, and (2) internal measures to determine compliance with, and success of, the strategic plan.

Current measures of effectiveness include 31 micro-economic impact studies that NIST has conducted over the past ten years to quantify the impact of their work. These provide a compelling, but incomplete story of the effectiveness of NIST work. They are only a small, carefully chosen, sampling of the complete body of work and are conducted on a micro-economic level, typically restricted to estimating the direct impact on one (or a few) industries. Traditional output measures, such as number of publications, sales of Standard Reference Materials (SRMs), number of calibrations, etc., may not be fully under the control of the organization. For example, the introduction of National Traceable Reference Materials (NTRMs) has reduced the need for some SRMs. Thus, while traditional output measures are useful in measuring change, they should be used carefully.

The NIST 2010 Strategic Plan also provides an excellent vehicle for NIST to better articulate its message that it will continue to provide significant economic benefit to the U.S. economy. The next revision of the Plan should identify clear and reasonably direct economic benefits for each of the major elements. Estimating such benefits can be difficult since the role of standards is infrastructural and generally hidden in the development process, but NIST has developed some credibility and expertise with its retrospective studies and is now in a better position to develop meaningful prospective estimates.

To ensure that NIST is able to deliver on its projected benefits, organization-wide performance metrics must be developed for the portfolio of its projects. Levels of metrics should cascade down through the levels of the strategic plan with direct application to the research programs.

NIST is making progress on a NIST-wide balanced scorecard, and now has two or three metrics in each of the five main areas of management priorities. Several of the metrics are currently included in OU Director performance plans. However, the Baldrige criteria should be reviewed for applicability toward developing a better, balanced scorecard with leading indicators. Measuring customer satisfaction appears difficult, but is being done in industry, and NIST is encouraged to include such measures.

B. Safety

The VCAT remains firmly supportive of improved safety and appreciates the increased emphasis on safety at NIST. Indications of the increased emphasis at the management level include: making safety the first business item in every Senior Management Board meeting, preparing a comprehensive safety plan, and having managers and supervisors visit private industry (specifically the DuPont Experimental Station) to learn about their safety practices. There is a new website on safety that informs staff on how to report injuries and hazards, provides copies of the latest safety plans, reports, and best practices, and provides information about the safety office and its activities in Gaithersburg and Boulder. A new safety training program, which focuses on investigation and root-cause analysis of safety-related incidents, is now available for managers and is required for all

supervisors. And, an element on safety is in all management and staff performance agreements.

Despite these efforts, there has not been a significant decrease in either the lost workday incident frequency rate, or the lost workday incident severity rate at NIST overall. NIST is still higher than the Department of Commerce average. The incident rate in the Laboratories may not be significant for any particular year, as it is fairly low and thus can be perturbed by one or two incidents, however there is no long-term downward trend. Presently, NIST is focusing on reducing injuries in the Office of the Director for Administration/Chief Financial Officer. These are the people who take care of the facilities and are subject to greater risks.

The Committee understands and appreciates the management emphasis on safety but is concerned that this emphasis has not been entirely embraced by the staff. A plan should be developed to include the staff in actively reducing the reportable injury rates. The Committee observes that there are inconsistent practices for wearing personal safety protection equipment. Further, not all injuries may be reported; there is no mechanism to evaluate this potential problem. Some suggested steps are to implement a hazard identification system and to reinforce positively the reporting of incidents.

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NIST biomedical engineer places a water sample on a tiny sensing chip that detects toxic chemicals.

C. Organizational Efficiency

Reorganization

The VCAT is very supportive of the reorganization of senior NIST management positions and of the choice of individuals to be part of the top executive team. This change gives the NIST Director, and his team, an opportunity to help prioritize, and deal with, the issues affecting the organization and to develop clear areas of responsibility. However, the areas of responsibility of the team members are not fully clear at this point, and further work is needed to define those responsibilities to minimize overlap between team members and to free the NIST Director to focus on external relations.

The NIST Chief Information Officer (CIO) position was officially implemented on May 4,

2003 to advise NIST on the use of information technology, and with a support organization, to provide computing and networking services. The CIO has significant challenges ensuring that mandated federal requirements are met, and that service is provided efficiently and supports the mission of the agency. The incorporation of the CIO organization within the Director's Office is a positive sign. The VCAT has identified the establishment of such an office, that has responsibility for all IT expenditures, as a significant opportunity to provide quality customer service while realizing savings from consolidation of IT services purchases.

Strategic Partnerships

Improved collaborations with appropriate organizations are critical to enhancing NIST's ability to carry out its mission in a climate of flat or declining budgets. NIST effectively reaches out to a variety of organizations at the bench level, but has historically not explicitly developed effective partnerships though management initiatives. Thus, NIST's progress during the past year in developing external partnerships is exciting, particularly the joint Postdoc program with NIH. This is an excellent approach to achieve some leverage without conducting all the research at NIST. This is an opportunity that can become a model for other technical areas. The Committee challenges the NIST management to continue to develop partnership models, possibly with a large virtual component, with institutions remote from NIST's physical locations, as an aid to broadening its support base.

Budget

Although the budget situation for FY2003 is not as alarming as last year, there is a continuing concern that the budget process is not stable, and with increasing needs for Homeland Security and the war in Iraq, there will be pressure to maintain or reduce NIST's budget. This would produce a critical situation as NIST is at minimal funding levels now and must be adequately funded to fulfill its unique mission within the federal government for developing and maintaining a measurements and standards infrastructure. As new national needs continue to be identified, e.g., homeland security, which have significant infrastructural needs for measurements and standards, NIST needs funding to help develop a program that is complementary to the work of the lead agency. This will promote efficiency without creating a redundant infrastructure.

Further, a mechanism needs to be found to promote stability and long-range direction of the agency's budget. Annual budget debates reflecting conflicting viewpoints regarding funding of the extramural programs, MEP and ATP, have confounded discussion of funds for NIST's core mission and its ability to maintain its facilities. The Advanced Technology Program is a useful, well-administered program with modest impact. But, the Committee sees budget priorities as continued stewardship of the facilities, preservation of the core mission, and stabilization of funding for the extramural programs, in that order.

The development and implementation of the NIST 2010 Strategic Plan is a good step toward ensuring that NIST is applying its resources efficiently to the appropriate tasks. With the strong economic benefits that NIST is encouraged to include in the next revision, NIST will be able to demonstrate the consequences of inadequate funding and the extent to which they can reprogram and reallocate resources to meet new needs.

III. Committee Review Activities

The Committee meets quarterly with NIST management and staff at NIST's Gaithersburg (March, June, December) and Boulder (September) locations. This year, in addition, several Committee members made visits to the Secretary of Commerce, selected members of Congress and their staff, and staff analysts at the Office of Science and Technology Policy and the Office of Management and Budget. The major points discussed at these meetings are summarized below. Additional information may be found in the meeting minutes on the VCAT Web site, http://www.nist.gov/director/vcat/.

A. Strategic Plan

Planning Process

Future priorities for NIST were set at the Senior Management Board (SMB) Spring Retreat, April 3-4, 2003. An agreed-upon strategic focus includes articulation and implementation of NIST's long-term strategic plan, and defining or reaffirming NIST's role in the National Measurement System. Operational focus topics included continuous organizational improvement, improved operating effectiveness, and improved leadership and management development.

A review of the five phases of development of the strategic plan is as follows:

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World-leading NIST research on quantum computing and communications includes a recent demonstration of a device that can count about 20,000 photons per second.

Phase 1, Organizational Development - A major result of this effort was the emergence of a distinct NIST-wide sense of programmatic purpose.

Phase 2, Environmental Analysis - Three broad Strategic Focus Areas (SFAs)--nanotechnology, health care, and information/knowledge management--were developed in response to a challenging assessment of potential changes in the long-term R&D environment. Post September 11, a fourth in homeland security was added.

Phase 3, Opportunity Assessment - Specific opportunities for NIST were characterized in those previously-defined broad areas by teams led by the OU Directors and NIST Deputy Director. The result was a series of SFA reports that recommended specific opportunities and resource needs. These reports were the basis for the first draft of the strategic plan.

Phase 4, Review - A management review of the opportunities produced a revised version of the strategic plan. This plan was used to select programmatic budget initiatives in FY2004.

Phase 5, Implementation - Implementation was started though resource allocation at the OU level. The NIST Director reviewed and approved the 2-year operational plans for each OU. These plans were developed, at the Director's request, to describe the work portfolio of each OU and demonstrate how it is moving into alignment with NIST's long term strategic goals. This will result in incremental adjustment of NIST programs toward the agreed-upon long term goals.

Implementation of the Strategic Plan

NIST has completed steps 1 though 4 and the individual NIST Operating Units are now gradually adjusting their work portfolios and competencies to align to the strategic plan.

A NIST physicist inserts a wafer into a low-noise electrical probe station as part of a project to develop methods for testing the electrical properties of molecules.

Given the current environment and budget situation, NIST management has decided to focus near-term on implementation of two of the programmatic SFAs: homeland security and nanotechnology (i.e., nanoscale measurements). To develop a coherent explanation of NIST homeland security activities in the context of the Department of Homeland Security needs, two planning reviews were held. For nanotechnology, NIST is in the process of identifying those capabilities that can position it uniquely in the marketplace.

National Measurement System

The Senior Management Board perceived the need for NIST to reaffirm its commitment to its traditional measurement and science mission, to enhance its national leadership, and to maximize the impact of its work. The need to focus on its traditional measurement and science mission was highlighted in responses from the recent employee survey. This is a relatively new effort, but the SMB has identified and initiated a number of tasks, and is encouraged by this progress. The Board has not yet reached convergence. More work is needed and planned. The approach is to break the goal into two pieces: to reaffirm NIST's role as leader of the Nation's measurement system, and to define how best to perform that role to maximize NIST's impact. The final step is to develop a marketing plan.

The concept of a National Measurement System (NMS) was started in the 1960s under then-NBS Director Allen Astin. NIST has developed some definitions of the NMS that are exact, contain a great deal of caveats, and are fine for internal discussion but need to be honed for external consumption. Different definitions for the NMS will be needed for different audiences. The present NMS definition only addresses some of the needs of the country, and it must be integrated with the national measurement systems of other countries. By 2020 the NMS should evolve to a global measurement system, with particular emphasis on how this serves the customer.

B. Strategic Focus Areas (SFAs)

As noted above, NIST management has decided to focus near-term on implementation of two of the programmatic SFAs: homeland security and nanotechnology. NIST is at the beginning of implementing NIST 2010. In an environment of static resources this will require reprogramming existing resources. This is being done at the OU level where NIST believes that customers and customer needs can be best understood.

Homeland Security

NIST presently has activities that tie into almost every function of the new Department of Homeland Security (DHS). A NIST Division Chief, Bert Coursey, has been detailed as Director of Standards in the Office of Research and Development in the Science and Technology Directorate. A National Research Council report on "Making the Nation Safer: The Role of Science and Technology in Countering Terrorism" described how science and technology could support the DHS, and specifically mentioned NIST, but at this point enabling legislation does not give NIST a specific role in the Department's work.

However, NIST is working closely with the DHS in developing a standards infrastructure. There is a tremendous demand for standards for homeland security and applicable standards have been developed in a fragmented fashion. Neither the federal government, nor the nongovernmental sector, presently has a comprehensive, consolidated program for developing new preparedness standards. The NIST role in homeland security standards development will be to provide critical technical expertise and support for standards development in key areas and, where appropriate, to coordinate and facilitate standards development activities. Mary Saunders, who is co-chair of the American National Standards Institute (ANSI) Homeland Security Standards Panel (HSSP), will be involved with DHS and developing homeland security standards. There will be a push to develop standards and certifications much more quickly than usual, and perhaps develop interim standards. These are approaches that are new to NIST and will require changes in the way NIST traditionally operates.

NIST presently has about 120 ongoing homeland security projects. These are funded with more than $50 million of NIST-appropriated funds and other agency funds. Example projects that the Committee heard about include: the National Construction Safety

Team Act, which gives NIST new authority to gather evidence at building disasters and allows them to establish an advisory committee; detection of radiological and nuclear threat material; the World Trade Center investigation; characterization of trace explosive detection equipment for airport security applications; concealed weapons detection; metal detector standards; gas mask performance standards; first responder interoperable communications; standard references for bullets and casings; and longer-term projects for tomographically imaging luggage and cargo containers.

The NIST role needs to be better understood by other agencies, have a single point of contact in support of DHS, and have a defined responsibility to work with DHS.

Nanotechnology

For nanotechnology, NIST is in the process of identifying those capabilities that can position it uniquely in the marketplace. Two clear roles have been identified: measurements and standards, and critically evaluated data. NIST needs to maintain focus on its role of providing measurements standards and data in an environment where many people are working on nanotechnology.

NIST expects a 50 % increase (FY2002 to FY 2004) in nanotechnology related research as a result of reprogramming. NIST is exploring partnerships with the University of Maryland, the National Institutes of Health (NIH), and others, in developing a nanomanufacturing center. A major portion of nanotechnology investment at NIST will be in the Advanced Measurement Laboratory. The creation of state-of-the-art clean rooms offers NIST opportunities for strategic partnerships. Current NIST activities in nanotechnology include: nanomagnetics, single photonics, quantum information, nanoparticle, single molecule measurement and manipulation, and gene expression. The intent is to characterize the present NIST portfolio relative to the NIST 2010 strategic plan and, through decisions and resource allocation at the OU level, realign this and future work consistent with the plan. The problem is to effectively apply NIST resources

A hand-held detector is used to check for radiation emissions from a truck trailer. NIST is collaborating with other national organizations to develop new standards for a variety of radiation detectors and monitors.

to a variety of technical opportunities serving a variety of industries. The next steps are to establish an on-going customer focus. Presently, some NIST work does not address specific markets.

Information/Knowledge Management

The VCAT heard presentations on projects which support three broad, high-level opportunities within Information/Knowledge Management: trustworthy computing, interoperability technologies, and virtual measurements and dynamic data evaluation.

Trustworthy computing can be defined as being able to make good decisions based on valid data, and having confidence in the information used. It is the vehicle for achieving a level of reliability that results in complete confidence in the system output. It requires a systemic approach addressing multiple aspects including functionality, performance, security, and dependability. To start, infrastructure technologies should be functionally correct, thus NIST has a strong program in XML technologies and networking protocols. Other NIST work, which was described, is designed to ensure trustworthy computing in voting systems, health care informatics, homeland security, and ensuring access to legacy data. Most of NIST's work focuses on conformance testing. This provides a significant benefit to industry standards-developing-groups since, as NIST develops the testing program concurrently with the specification, they can provide feedback to the group on potential ambiguities.

Headlines show that U.S. manufacturing is in a rapid decline due to increasing manufacturing in China, and further competition is expected resulting from the European "Sixth Framework" industrial research initiative. To be competitive, U.S. industry needs to transfer data, information, and knowledge throughout the design and manufacturing system seamlessly and efficiently. Interoperability throughout the supply chain is critical to reducing costs, time, and improving the product. NIST will provide technical leadership and participation in standards development organizations and perform collaborative research with OEMs and Small Manufacturing Enterprises (SMEs) in multiple industry sectors. A second aspect of the problem is assuring conformance with the standard, and NIST is active in developing testbed and reference implementations to test conformance with newly developed standards.

There is an increasing reliance on modeling and information systems for the materials, ceramics, glass, energy, and chemical industries; all of which require reliable data. Provision of physical, chemical, biochemical, and materials property information and data is a traditional NIST role. To facilitate data collection, NIST is helping to develop data exchange standards including structure identification standards and software. NIST is working with academia and other government agencies to enhance and improve the Protein Data Bank (PDB), a structural archive for atomic coordinates of biological macromolecules and assemblies. NIST is developing expert systems in information synthesis to replace the highly skilled experts that presently review the data. This approach, not only will reduce the time and cost to produce reference quality recommended data specifically tuned to current customer needs, it could ultimately provide tools that customers can use to facilitate their assessment of data quality. NIST is also researching virtual measurement (expert) systems. These can be used to fill the gaps in experimental data by computationally predicting the data from appropriate estimation schemes or first principles quantum chemistry and molecular simulations thereby "making" measurements that are not possible or too expensive to make in the lab.

Customer Focus

The Industrial Liaison Office was created to target specific industries to determine what current, or potential NIST products and services are needed. Specifically, the Office analyzed a portfolio of

NIST projects and selected 11 on which to survey industry for feedback. Of the 80 surveys returned, the importance of NIST work was often rated high, and many of those surveyed asked for additional information.

A pilot project focused on the automotive and health care industries. One result of these interactions with industry is that the Automotive Industry Action Group (AIAG), a not-for-profit association of companies involved in the automotive industry, is advocating for NIST to their 1500 members. Other outcomes are an increased interest in licensing of NIST work and developing Cooperative Research and Development Agreements (CRADAs). In at least two cases, a project was in transition and the pilot project helped them move to better support the automotive industry.

Several lessons have been learned from the pilot project. Project level feedback is very useful but difficult to do comprehensively. Future interactions will need to focus on portfolios of projects. Direct one-on-one interaction is very important. Industry is very interested in the portfolio-level of detail, and wants a single point of contact at NIST. There is an ongoing need to align industry needs with the NIST Strategic Focus Areas (SFAs).

Also as part of the project, a database of existing NIST projects, KnowledgeNet, was created. KnowledgeNet is publicly available for industry viewing. The Public and Business Affairs Division reports a number of external contacts that reference the database. Information in the database includes the project name, a description of the project, the name of the Principal Investigator, and contact information for the Principal Investigator.

This year, the Office is in transition from pilot program to an established role. Key recommendations accepted by the Senior Management Board are to shift the focus from the project level to the portfolio level, ensure that established outreach channels will be maintained, get additional customer input on future NIST plans, and institutionalize the customer liaison role within the NIST Program Office.

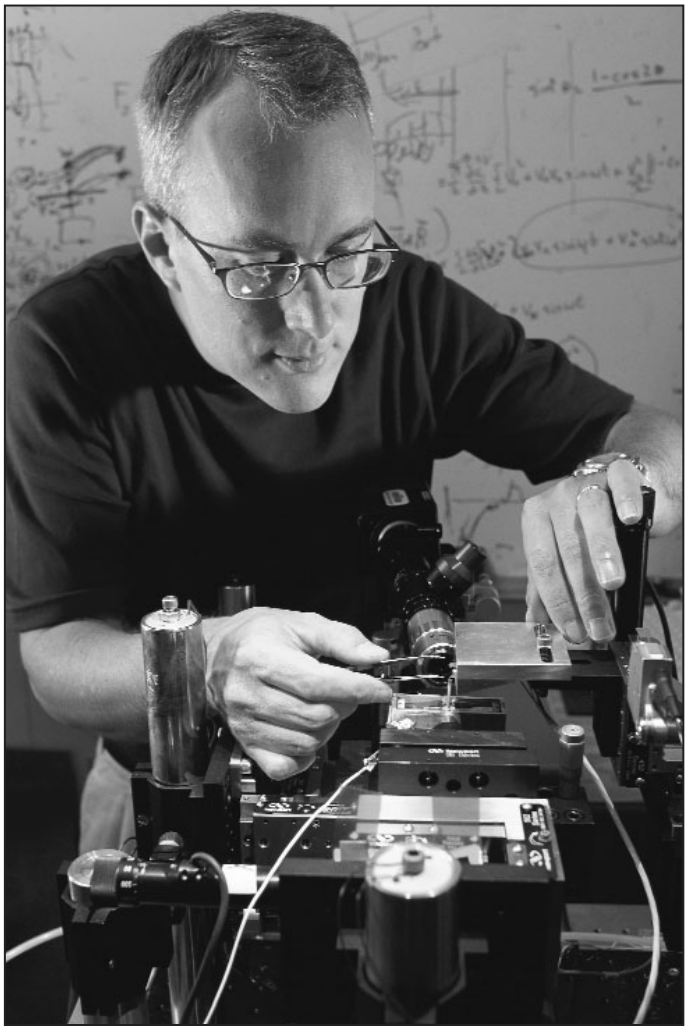
C. Program Results

Measuring NIST's Economic Impact

NIST has been at the forefront of government agencies in assessing the economic impact of its programs. Over the past ten years, NIST has conducted 31 independent, retrospective impact studies. The selection was not random; however, projects were selected based on their assessed potential for revealing the range and magnitude of NIST economic impacts. In all cases, estimation of the benefits accrued has been limited to a specific time period and to the industries directly targeted by the research project. Usually, this has meant one to three industries.

This methodological approach used by NIST requires multidisciplinary consultant teams. NIST has certified a small number of firms that are capable of performing these analyses. One of the early deliverables of these studies is a description of the technical outputs of the program. With these outputs in hand, one can develop an analytical framework for estimating the economic impacts. Profits and employment are the critical elements in the business sector's contribution to the GDP; therefore, these two metrics are the preferred objectives of the economic analysis.

Other difficulties arise when one estimates economic impacts from government R&D projects. Whereas corporations collect economic impact data in real time, government economic studies require going back in time to collect impact data. This puts constraints on the time periods that can be addressed by the study. It is also important to know where in the technology life cycle the government program is having an impact to properly quantify the impact and the cost of government technical support.



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An adjustment is made to the prototype NIST Electrostatic Force Balance designed to measure nanoscale forces.

NIST has developed an excellent database from these studies which gives it some credibility for conducting prospective studies to support its strategic planning process. Here the scope is broader; first one must look at industry sectors, and then using appropriate methodology to extrapolate the benefits to the larger U.S. economy.

National Research Council Board on Assessment of NIST Programs

Dr. Linda Capuano, Chair of the National Research Council/National Academies Board on Assessment of NIST Programs reviewed the Board's recent evaluation of the NIST Laboratories. The Board was asked to review the NIST laboratory programs based on (1) technical merit; (2) relevance to customer needs; and (3) adequacy of facilities, equipment, and human resources. The assessment is the combined judgment of 150 panel members, comprised of a very diverse group of industry, university, and agency representatives. The 2003 review process took one year with a new member orientation session held in December 2002, laboratory visits conducted in January through March, and a final report delivered in September 2003.

The Board has developed a process of continuous improvement. Improvements this year included: defining and disseminating the themes for the assessment in December, implementing a vice-chair position in order to smooth the leadership transitions, and implementing skip-level sessions and feedback sessions with Laboratory Directors. Another change implemented this year is biennial reporting, starting with the 2004-2005 cycle. An official report will only be issued in odd years although panel meetings will continue every year. This will put less emphasis on report writing and more time on individual peer-to-peer contact. Panels will also clarify their data needs to reduce the amount of preparation by NIST, and hold longer panel meetings to expose members to multiple Divisions.

Briefly summarizing the findings of the Board, Dr. Capuano reported that the technical quality of NIST's work is high: very good to excellent. NIST has successfully

achieved a good balance between research and services, and programs are well aligned with NIST's goals and missions. Programs are generally aligned with the needs of the currently identified customer base, and NIST works to achieve a balance between good customer focus and new program development. NIST has also demonstrated its flexibility to react to unanticipated needs, as exemplified by its responsiveness in homeland security activities. NIST strengths are its expert staff, but budgets are eroding staffing levels. As a result, NIST needs to continue to emphasize succession planning. The equipment and facilities situation is mixed. Upgraded facilities and equipment are excellent, but legacy systems are deteriorating. When NIST has the budget, they do a good job of identifying effective and efficient equipment, but constrained budgets present difficulties.

The NIST Strategic Plan has been effectively guiding its programs. The Board sees continuous improvement in the way strategic planning is impacting NIST actions. The Board is aware of a lot of collaboration at the bench level and the Board encourages more collaborative planning at the higher levels. Finally, in an era of flat budgets the Strategic Plan takes on greater importance to more clearly define critical new research areas, and those areas that can be considered less strategically important.

D. External Interactions

S&T Priorities in the Administration

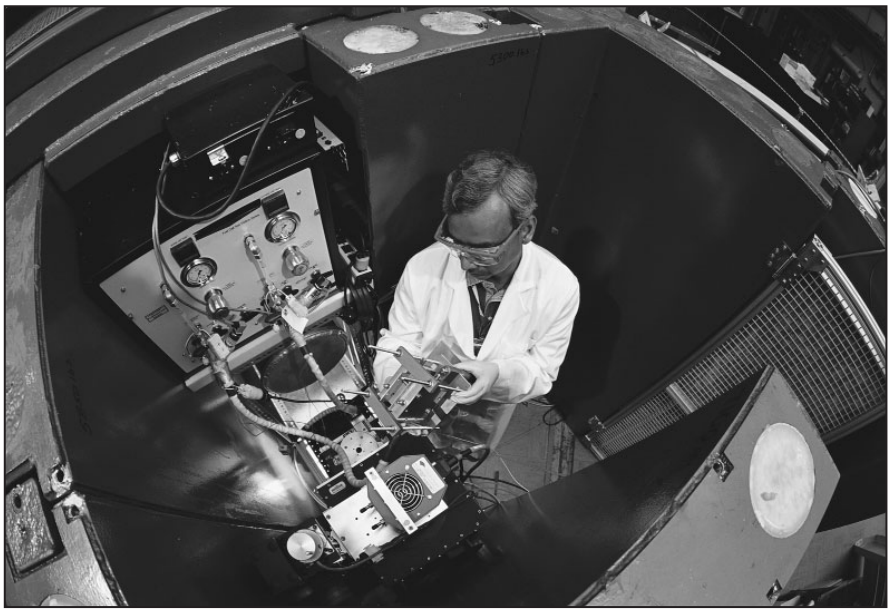
Dr. Kei Koizumi, Director of the American Association for the Advancement of Science (AAAS) Budget and Policy Program, described his organization's activities tracking the federal budget and gave VCAT members an early insight into the FY2004 budget and its implications for NIST. AAAS is a non-profit membership organization with 132,000 members and is a one-stop resource for federal funding information.

The priorities in the FY2004 budget are for tax cuts. Budget forecasts show budget deficits, with no return to surpluses in sight. The FY2004 budget (as of March 2003) did not include any estimates of a war with Iraq or a Medicare drug benefit. Thus, the Department of Commerce and other agency budgets will likely be flat for the near term. Dr. Koizumi noted that non-defense R&D has been increasing substantially since 1997, however that was largely due to a budget surplus and a campaign to double the NIH budget. Commerce and other domestic R&D agencies have not had significant increases since the 1980's. Overall Commerce R&D is down 12 % for FY2004, resulting from the proposed elimination of ATP and MEP.

Strategic Partnerships

NIST is developing opportunities to partner with other government agencies and universities and is meeting with various industry groups to strengthen relationships with them. In particular, meetings have been held with representatives from the automotive industry and the health care industry. NIST brings a unique mission, world renowned scientists and engineers, and unique capabilities and facilities to a partnership. Example facilities include: the NIST Center for Neutron Research (NCNR), the (soon-to-be) Advanced Measurement Laboratory (AML), and the Advanced Chemical Sciences Laboratory (ACSL). The NCNR is the most versatile neutron user facility in the U.S. with more than 1750 annual users. The ACSL has cold rooms for biotechnology research and an excellent ventilation system and capabilities to handle corrosive chemicals.

Dr. Esin Gulari, Acting Assistant Director for Engineering, of the National Science Foundation (NSF) recently visited NIST, and was given a tour of the NCNR as a prelude for exploring closer relationships in nanoscience and engineering. NIST currently has a Memorandum of Understanding with NSF and is working to expand it to sponsor new fellow-



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Preparing a fuel cell for neutron imaging at the NIST Center for Neutron Research.

ship and training programs at NIST. Dennis O'Connor, Vice President for Research and Dean of Graduate Studies, University of Maryland, visited NIST on March 5, 2003 to discuss possible opportunities to increase collaboration, particularly in the area of nanofabrication. This is part of an ongoing relationship to explore potential areas of interaction.

Angela Hight Walker is working to establish a new Postdoc program with the National Institutes of Health (NIH). This program will provide for a two-year research project with one year spent at each institution. Scientists at both institutions will work together to manage the Postdoc's research and learn about each other's work. Advertising for positions began in June 2003. The most notable feature of the program is that NIST and NIH equally fund it with two advisors per fellow, one from NIH and one from NIST. Funds are available for five postdoctoral fellows. It is expected that the researcher will spend approximately equal time at NIH and NIST. The program was announced in March 2003 to NIST and NIH staff and 50 joint research project descriptions have been collected.

As reported earlier, NIST is also exploring partnership opportunities with the National Institute of Biomedical Imaging and Bioengineering (NIBIB), a newly created institute within NIH. The NIBIB is looking to NIST for its expertise in physical science measurements. NIST has been participating in their strategic planning process, and the NIST Director sits on the NIBIB Advisory Council. The NIBIB Director and executive team have visited NIST and a draft MOU with NIBIB is underway, where NIBIB would co-locate their intramural program at the NIST site.

NIST is also working closely with DHS in developing a standards infrastructure. Mary Saunders is co-chair of the American National Standards Institute (ANSI) Homeland Security Standards Panel (HSSP) and will be involved with homeland security standards. Further, Bert Coursey has been detailed as Director of Standards in the Office of Research and Development in the Science and Technology Directorate.

Meeting with Secretary Evans

The Visiting Committee members met with Department of Commerce Secretary Evans on December 11, 2002. The VCAT expressed their pleasure with the steps that Arden Bement, the NIST Director, has taken to change the organization to be responsive to the changing environment. They were particularly appreciative of his efforts to include broad participation by the Operating Unit Directors. They agree that the focus on homeland security is a proper one for NIST and application of NIST's varied competencies to these problems will likely significantly benefit the Nation. The Committee commented that they have reviewed the NIST 2010 Strategic Plan, are pleased that NIST is moving forward with it, and anticipate a healthy interaction between NIST and the Committee with this process. They also thanked the Secretary for his support on the budget issues and encouraged him to remain focused on maintaining adequate funding for Adjustments to Base and equipping the Advanced Measurement Laboratory.

Meetings with Congressional members and staff

During the past year, Committee members met with a variety of Congressional members and staff primarily to discuss the NIST budget situation. In each case, the meeting gave the members an excellent opportunity to expound their message that NIST is a well-run and valuable organization that is contributing significantly to the U.S. economy. Further, the Committee voiced its recognition that developing industrial support for NIST is difficult, as the role of standards is infrastructural and generally hidden in the development process. However, it was learned that industrial sector support is critical to raising awareness within Congress of the value of NIST.

On March 19, 2003, eight VCAT members met with Mr. Mike Quear, Professional Staff Member of the House Science Subcommittee on Environment,

NIST physical scientist positions a tissue-engineering polymer scaffold sample for imaging with a new dual microscope system.

Technology, and Standards. Also attending was Jennifer Barrett, Senior Legislative Advisor, Office of Representative Mark Udall. The same Committee members met later in the day with Representative Vernon Ehlers, Chairman, House Science Subcommittee on Environment, Technology, and Standards; David Goldston, Staff Director, House Science Committee; John Mimikakis, Deputy Staff Director, House Science Committee; and Eric Webster, Staff Director, House Science Subcommitee on Environment, Technology and Standards.

On June 11, 2003, several members of the Committee met with Jean Eisen, Democratic Professional Staff Member, Senate Committee on Commerce, Science, and Transportation. Members also met with Representative Gill Gutknecht (R-MN) on the same day. For the final visit that day, members met with Mr. Floyd Des Champs.

Meeting with OMB and OSTP staff

Meetings with OMB and OSTP staff were arranged at the request of the VCAT to convey their views and findings related to the programs, budget, and strategic direction of the NIST. On October 15, 2003, two members of the VCAT met with Erin Wuchte, the OMB Examiner for NIST, and Randy Lyon, Chief of the Commerce Branch in OMB. The OSTP meeting included Kathie Olsen, Associate Director for Science, and Richard Russell, Associate Director for Technology. Patrick Looney and Sharon Hayes also attended. The VCAT and OMB agreed to meet at least on an annual basis, and the VCAT members encouraged OMB to contact them directly at any time.

E. Laboratory Tours

To gain an appreciation for the technical excellence of NIST research, Committee members periodically visit laboratories that are related to presentations to the VCAT. In 2003, members visited and held discussions with staff in the following laboratories:

Advanced Measurement Laboratory (AML) Mr. Jorge Urrutia, Director for Administration and Chief Financial Office, gave members an overview of the planning and construction progress of the AML. Members were then conducted on a tour of the partially-finished Instrument East laboratory building.

Homeland Security

- Detection of Radiological and Nuclear Threat Material, Leticia Pibida, Dr. Michael Unterweger and Dr. Lisa Karam, Physics Laboratory
- World Trade Center Investigation, Dr. Frank Gayle, Dr. Richard Fields and Steve Banovic, Materials Science and Engineering Laboratory.
- Characterization of Trace Explosive Detection Equipment for Airport Security Applications, Dr. Greg Gillen and Robert Fletcher, Chemical Science and Technology Laboratory.
- Concealed Weapons Detection, Erich Grossman, Electronics and Electrical Engineering Laboratory
- Maintaining the Nation's Critical Infrasturcture-World Trade Center Investigation, Pipeline Infrastructure Protection, J. David McColskey and Dr. Alan Clark, Materials Science and Engineering Laboratory

Nanoscale Measurements

- Single Molecule Measurement and Manipulation, Dr. Michael Gaitan, Electronics and Electrical Engineering Laboratory
- NIST Fountain Clock Time Standards, Dr. Steven Jefferts, Physics Laboratory

Biometrology

- Tissue Engineering Metrology, Dr. Newell Washburn, Materials Science and Engineering Laboratory, and

Dr. Anne Plant, Chemical Science and Technology Laboratory

The laboratory tours were considered excellent this year. An improvement was to split the group into two or three smaller groups which allowed the members more interaction with the NIST staff. The Committee, as expected, was impressed with the outstanding work and the quality of the people. One challenge for NIST is to communicate the availability of that talent to potential external strategic partners.