

STATEMENT OF ARATI PRABHAKAR

DIRECTOR

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

BEFORE THE

SENATE SUBCOMMITTEE ON

SCIENCE, TECHNOLOGY, AND SPACE

JANUARY 31, 1995

Mr. Chairman and Members of the Subcommittee, I welcome the opportunity to discuss with you the work of the National Institute of Standards and Technology, and to explain how our efforts are helping to strengthen the U.S. economy.

I especially want to applaud you, Mr. Chairman, for scheduling an early hearing that allows the Subcommittee to gather more facts about our programs to help you make critical decisions that will affect the future of U.S. industry.

NIST's mission is straightforward and unique. As part of the Commerce Department's Technology Administration, NIST promotes U.S. economic growth by working with industry to develop and apply technology, measurements and standards -- providing the basic technical infrastructure needed by U.S. industry. We concentrate on industry because it is industry that transforms technology into the products and services, the profits and jobs that yield the true returns to American taxpayers.

I want to put NIST's efforts into perspective by setting out four fundamental principles that drive all of our work:

- o NIST focuses on critical jobs vital to the country's technology infrastructure that neither industry nor the government can do separately. These are technology jobs that private companies cannot or will not take on by themselves -- because they cannot capture the broad-based benefits that will accrue to the economy at large, or because the time-frame is too long and the risk too great. Before we take on a task, we must be assured that our efforts do not replace or substitute for any efforts by the private sector.
- o Industry drives all of our priorities and plays a critical role in helping us to carry out our work. Industry's priorities, not government's, guide NIST's work.
- o Rigorous, open, technically sound and competitive processes are the hallmark of all of our efforts. All of NIST's programs are strictly merit-based and have long been executed free from political influence.
- o We rely heavily on evaluation of our work to ensure that industry and the taxpayers are receiving the greatest possible return on their investment.

Mr. Chairman, I will unabashedly assert that NIST can deliver the greatest economic bang for the buck out of the entire \$70 billion the federal government invests in research and development. Our laboratories already have a 90-plus year history of working closely with small and large companies, coupled with a reputation

for neutrality and technical excellence. That is why NIST was selected by Congress in 1988 to tackle these added assignments -- the Advanced Technology Program and the Manufacturing Extension Partnership.

Unlike any other R&D-oriented federal agency, *everything we do* is designed to partner with industry to strengthen our economy. Our successes in assisting U.S. companies are not accidental -- and they are not spinoffs. They are the very reason why we exist.

It is still too early to claim broad-based impacts on our economy for these newer programs -- they have only recently moved out of the start-up phase. But we already have indicators that point to the kinds of successes that Congress, industry and all taxpayers should demand from government agencies.

I will back up those statements with some details about our efforts. But there is one other point I want to highlight.

NIST's appropriation of \$855 million in fiscal year 1995 is the only portion of the federal budget devoted explicitly to enhancing and leveraging industry's development and use of technology -- and it amounts to just over one percent of federal R&D and less than one-half of one percent of the nation's total R&D expenditures. As we talk about the value of our efforts and NIST's impact in helping industry, we need to keep this sense of proportion in mind.

NIST has a portfolio of four major programs designed to meet needs identified by industry. I would like to briefly describe each program, explaining our principles, our progress, and some of the results that we have delivered recently to industry.

ADVANCED TECHNOLOGY PROGRAM (ATP)

The Advanced Technology Program is a rigorously competitive program which invests in cost-shared research by individual companies or industry-led joint ventures. The sole aim is to develop high-risk, potentially high-payoff enabling technologies that otherwise would not be pursued at all or in the same market-critical time frame because of technical risks and other obstacles that discourage private-sector investment. These other obstacles include long pay-back horizons, or anticipated returns that are distributed so that individual firms or specific industrial sectors are reluctant to invest.

ATP is industry-oriented. While government provides the catalyst -- and in many cases, critical technical support -- industry conceives, manages, and executes each ATP project. Industry proposals are based on the private sector's understanding of market trends and future opportunities. All projects are

selected on the basis of both technical and business merit through a fair and rigorous competition that draws on both government and private sector expert reviewers.

Mr. Chairman, it remains fashionable to talk about "picking winners and losers." That phrase truly yields more heat than light. In one sense, "picking winners and losers" is the old way of setting federal R&D priorities. The federal government long ago picked agriculture, aeronautics, space, energy and health. The whole point of the ATP is to maximize economic impact by letting industry's ideas -- backed up by their financial commitment -- determine what is funded. That is the new concept in federal R&D that is embodied in the ATP.

Suggesting that programs like the ATP pick winners and losers also underrates the tremendous efforts of our industries. Consider what it really takes for a company to make a winner in the market: product development, manufacturing and production, global marketing and sales, distribution and service systems. All of these jobs belong to industry, and ATP is doing none of them. ATP's job is to cost-share the high-risk, enabling R&D that is upstream of product development, creating new opportunities for companies to pursue.

The acid test is simple: ask any ATP participant what it will take to launch a successful product in the marketplace beyond the work being performed with government-provided funding. Their own investment will always be substantially larger than the government's relatively small cost-shared funding. And that added investment comes not from the ATP, but from the private sector.

I want to emphasize one other feature about ATP that has been too often misrepresented. The ATP works for companies of all sizes -- the tiny startup, the medium size company, and the large corporation -- as well as combinations of companies. To date, about half of the ATP awards have gone to small companies or joint ventures led by a small company. That represents a much greater small business involvement than typical federal R&D programs.

ATP Progress to Date

Overall, NIST has conducted 10 competitions and funded 177 projects to provide a little less than half the funding for over a billion dollars of high-risk research. NIST has conducted five *general ATP competitions* open to proposals from all areas of technology. Through these general competitions, we have made 121 awards, committing a total of \$332 million in ATP funds with \$370 million in cost-sharing funds from industry.

Through a series of public meetings with industry, we found widespread support for the idea that focused programs can help maximize the ATP's leverage by driving key strategic technology areas. Industry demonstrated that support by submitting nearly 900 ideas for focused ATP program areas since October 1993.

We have had several thousand industry representatives taking part in our ATP workshops. Those sessions have tremendous value, not just in helping to plan our program, but in convening different segments of industry to discuss mutual goals and interests.

NIST has conducted five *focused program ATP competitions*, all in 1994. We made 56 awards, committing a total of \$224 million in ATP funds with \$229 million in cost-sharing funds from industry. Last month, based on industry suggestions, we launched an additional six focused programs. We are just beginning those competitions now, and industry's involvement and interest is very strong.

With a total of 11 focused programs underway, the broad industry participation is evident in the range of topics: Manufacturing Composite Structures; Information Infrastructure for Healthcare; Component-Based Software; DNA Diagnostics; Computer-Integrated Manufacturing for Electronics; Materials Processing for Heavy Manufacturing; Vapor Compression Refrigeration Technology; Catalysis and Biocatalysis Technologies; Digital Video in Information Networks; Digital Data Storage; and Motor Vehicle Manufacturing Technology. These programs are each \$50-185 million efforts spread over four-to-five years. Companies from every sector continue to plan new programs.

To date, more than 400 organizations, including companies, universities, independent non-profit research organizations and government laboratories have participated directly in 177 ATP projects. The attached graphic gives you an idea of the growing number of companies, large and small, that have been able to participate in this program. In addition, several hundred additional organizations participate informally as subcontractors and strategic allies. Our ATP managers have carried out a vigorous outreach program to make firms and economic development organizations in states and localities across the country more aware of the ATP, its potential, and its procedures.

ATP Impact

ATP has placed a high premium on evaluation of its programs from the very start. Our process has five elements:

- o assessing ATP's own critical operational activities;
- o "portfolio" profiles of applicants, recipients, technologies, and projects;

- o evaluation of industry's implementation of both the R&D and business components of ATP projects;
- o tracking short-term and intermediate project results; and
- o measurement of long-term economic impacts.

What we really care about is that last category: long-term economic impacts. The primary goal of the ATP, and the real payoff, is the economic growth in the future that will come from the introduction of new products and industrial processes based on ATP-supported R&D. Ultimate ATP results occur significantly later than the ATP projects that cause them.

But because the ATP invests only in pre-product technology development, because it is still a very modest program in terms of the larger R&D enterprise, and because nearly all of the projects it funds are still in the research phase, no one should expect to see major impacts on the economy this soon.

Having said that, we can track some early indicators that the projects are on course and the economic potential is building.

- o **Encouraging high-risk R&D.** The ATP has been successful in attracting relatively high-risk R&D projects that otherwise would not be attempted.
- o **Promoting research efficiencies and reduced time-to-market.** The joint ventures and alliances fostered by the ATP are reporting significant research efficiencies and early use of research results.
- o **Progress on commercialization.** The results of ATP R&D projects are being incorporated into commercial products by companies. Information from 40 small companies revealed this progress:
 - 30 percent reported incorporating improvements resulting from the ATP project into existing commercial products.
 - 18 percent were implementing an improved production process resulting from the ATP project.
 - 38 percent were producing and shipping to potential customers commercial prototypes of products based on the ATP-funded technology.
 - 20 percent were producing and selling to customers products derived from the ATP-funded technology.

- o **Business growth.** An important measure of the economic impact of the ATP is the growth of companies -- particularly the growth of jobs -- as a result of ATP technologies. Immediate job growth as new research staff are brought in to work on a project is not the point; rather, we focus on projections of job growth as a result of the use of ATP-sponsored technologies. Recent data from 32 small firms working on ATP projects showed that over 90 percent expected to add new employees within five years as a result of ATP technologies. Nearly half of the companies expected to add substantial numbers of employees.

Those are some of the quantifiable early results from ATP cost-shared projects with industry, and they tell us we are on track. But remembering that it is the longer-term impacts that we are aiming for, there are two far more important indicators.

First, ATP is enabling U.S. companies to see entirely new market opportunities opening up with the development of revolutionary new technologies that break all of the traditional molds.

Second, these companies often are discovering that they can best take advantage of these new markets by teaming with other firms. The ATP has stimulated the formation of strategic R&D alliances both horizontally, among competitors, and vertically, between customer and suppliers.

Two examples provide insights about how ATP is meeting its goals and serving industry.

The Genosensor Consortium

One goal of the Advanced Technology Program is to help industry change the rules, to provide a springboard for revolutionary technological advances harboring big economic potential. An ATP project now under way by the Genosensor Consortium fits this ideal like a hand in a glove.

One of the consortium's major technology goals is to develop DNA analysis technologies that will take off where the Human Genome Project (HGP) stops. The HGP is a federally funded, multibillion dollar effort to map and ultimately sequence all human genes. An early payoff is expected to come in the form of more reliable and inexpensive diagnostic tools that can help reduce health care costs and human suffering through earlier intervention or lifestyle changes. In the longer term, the basic genetic knowledge developed in the HGP could help change the paradigm of medical practice. Rather than being relegated to responding to health problems that already have emerged, doctors could begin to shift their focus to managing -- even preempting -- potential health problems revealed through DNA analysis.

The Genosensor Consortium's six companies, two academic institutions, and independent research organization hope to realize that vision by developing plug-and-play, tabletop instruments capable of inexpensive and rapid analyses of DNA samples. This is the kind of tool that can convert the vast storehouse of data coming from the HGP into useful information valuable to doctors and patients, biotechnologists, public health officials, and many others. In addition, these same tools could open doors to more effective microbial screening of water supplies and food, to more affordable large-scale toxicological screening, and to more effective genetic engineering of plants and animals, and to chemical manufacturing applications.

That such a technology is needed is clear. With today's analytical methods, it takes days or weeks, skilled technicians, and at least \$100 for even the simplest DNA analysis. By synergistically combining the fields of microelectronics and molecular biology, the consortium aims to unlock the widespread potential of DNA analysis and develop an easy-to-use machine that can do analyses in less than an hour at a cost at or below \$10.

It is no surprise that the R&D challenge here is formidable, expensive, and risky. It requires the equivalent of miniaturizing a room-sized analytical laboratory onto a chip. With the ATP serving as the catalyst, the consortium formed because no one company had all of the in-house expertise in chemistry, biology, software design, microfabrication techniques, system engineering, and other technical areas to even prove the concept of a tabletop DNA analyzer. The ATP is providing a framework in which the financial and technical risks for each consortium member come down to acceptable levels. Consequently, by encouraging companies to share the risks, the ATP promotes the aggressive development of revolutionary technology that has historically paved the road to broad U.S. economic prosperity.

Auto Body Consortium

Assembling car bodies has a lot in common with assembling jigsaw puzzles. In both cases, each of many pieces must fit nearly flawlessly with its neighbors. Even minuscule misfits and misalignments can accumulate into unappealing results. The challenge for U.S. auto makers is to achieve manufacturing uniformity that improves quality, reduces costs and shortens time to market. Uniformity also is the key to tighter fitting doors, less wind noise, and fewer rattles and vibrations, all of which play pivotal roles in the perceptions and decisions of car buyers.

That is why in 1992 eight small technology suppliers joined to form the Auto Body Consortium (ABC) and teamed with General Motors, Chrysler, and researchers at the University of Michigan and Wayne State University. The ABC credits the ATP as the

catalyst for this trailblazing collaboration. The government provided \$4.8 million to the consortium of small companies. GM and Chrysler together pitched in \$2.25 million of the nearly \$6.5 million of matching funds required in the ATP agreement. In only three years, the effort has yielded versatile new software, mathematical techniques, manufacturing technologies, and ways of transferring information among researchers, suppliers and automakers. Together, these innovations can reduce the total variation of U.S.-made car bodies from the typical 3-5 millimeters to 2 mm or less -- roughly the thickness of a nickel. Toyota already had reached that level of uniformity to become the industry benchmark. European and other Pacific Rim rivals have been closing in. Now, because of the unprecedented common ground that the ATP provided -- even for arch rivals -- U.S. industry has caught up to the leaders. What's more it has done so in a way that promises a long-term competitive advantage. Similar to Toyota's approach, the ABC techniques and technologies maximize worker contribution, yet the ABC approach also harnesses America's unique advantage in innovative manufacturing technologies. The goal has been demonstrated in the manufacture of several vehicle models at the Chrysler Jefferson North (Michigan) assembly plant, the GM Shreveport (Louisiana) plant and the GM Linden (New Jersey) plant, where it took only 15 weeks to reduce variation levels to a world class 2.00 mm. Now that level is down to 1.74 mm. As discoveries have been made during this ATP project, which officially ends in September, industry has invested quickly to rapidly implement the newly validated manufacturing technologies into their assembly lines. With this proof that collaborative R&D can work, many in the auto industry seek to replicate the ABC model in other major manufacturing steps including metal stamping, welding and joining.

MANUFACTURING EXTENSION PARTNERSHIP (MEP)

The Manufacturing Extension Partnership is a true grassroots effort to improve the competitiveness of smaller manufacturers: companies with fewer than 500 employees that number more than 370,000 and account for about 95 percent of all U.S. manufacturing plants. The MEP helps these smaller manufacturers succeed in the marketplace by allowing them to improve their operations through the use of appropriate technologies. The computer revolution has yet to arrive at a surprising number of these firms; many still are using manufacturing technologies from the 1950s and 1960s. Meanwhile, competition overseas is getting tougher by the day.

These smaller companies are assisted by manufacturing engineers from MEP's growing nationwide network of affiliated manufacturing extension centers run by local, state and non-profit groups. The MEP takes maximum advantage of programs already in place, avoiding duplication of efforts among existing technology assistance organizations. It concentrates on matching company needs to available help regardless of source.

The MEP provides federal funds to both existing and new extension centers so that they can meet the needs of area manufacturers. All centers are chosen in rigorous, merit-based competitions, and all federal funding must be matched by the state. The MEP includes the State Technology Extension Program, offering support to states and communities so that they can begin building the foundation of organization relationships required for the efficient delivery of services, which might include a Manufacturing Extension Center. We are placing a very high priority on working with those areas of the country which do not yet have this foundation in place.

Having a nationwide system managed through NIST offers the centers a system-wide array of supporting services and information resources -- and discourages duplication of effort. As conduits to MEP client companies, the centers can increase the depth and breadth of expertise readily available to local firms.

As the client companies become more competitive, their prospects for long-term growth improve. So do opportunities for retaining existing jobs, creating new high-skill, high-wage jobs and reaping economic benefits related to maintaining America's value-added manufacturing industry, and additional service industry jobs needed to support that manufacturing base.

MEP Progress to Date

In 1993, fewer than one smaller manufacturer in 20 was located within the service areas of the seven federally sponsored extension centers. Since then, dramatic progress has been made.

Now, 44 MEP centers are operating or are preparing to open their doors in 32 states. Those non-profit centers employ professional engineers and others with manufacturing or business experience who are opening the doors to information and expertise for small manufacturers.

MEP partners with state and local governments to establish non-profit manufacturing extension centers in the nationwide MEP. These centers leverage state, local, and regional programs along with a widening national array of assistance efforts.

This expansion has been enabled by the Technology Reinvestment Project (TRP), led by the Defense Department's Advanced Research Projects Agency. The TRP has provided funds -- matched by state and local sponsors -- that enable the MEP to extend its geographic reach. Thirty-seven of the NIST-managed affiliated centers were funded by the TRP. TRP also has provided matching funds for training modules, assessment tools, and other services that will help the individual MEP centers to deliver quality services to client firms. The MEP is now well positioned to carry on the work that has been jump started by TRP funds.

Earlier this month we announced a jointly funded initiative with the Environmental Protection Agency (EPA) to help smaller manufacturers become both more competitive and more environmentally conscious. The initiative will support the development of methods and approaches to integrate environmentally focused services into the portfolio of manufacturing extension center services. It also will support the development of new tools to help manufacturing extension organizations deliver these services to smaller manufacturers. In addition, we will support the establishment of industry-specific pilot centers.

MEP Impact

Our centers have been busy. They served nearly 9,000 manufacturers during the first three quarters of 1994, helping smaller manufacturers through hands-on assessments and advice, technology demonstrations, training, and seminars on specific manufacturing and business-related issues.

Surveys of our client firms are showing that manufacturing extension services are fostering significant improvements in manufacturing and business performance, yielding company-estimated benefits that greatly exceed the federal investment in the MEP. For example, during that same nine-month period, 395 companies returning surveys to the original seven centers reported an economic impact of more than \$82 million for technical assistance projects provided by MEP. Those impacts include changes in sales, capital spending and capital avoidance,

inventory reductions, labor and material savings, and jobs created or saved. These results are consistent with our earlier evaluations.

The MEP is also sparking changes in the behavior of private and public-sector providers of extension services and advice. Federal support and access to a national network of supporting services is enabling previously existing, state-sponsored centers to extend their reach, develop new capability, and broaden the range of service available to companies. Moreover, private sector consultants are finding that, by working with the Centers, they have better access to smaller manufacturers as clients. A 1994 study found that MEP client firms are more aware of the competitive benefits of using modern technologies than non-client firms. They also are more likely to be planning to implement those technologies. More than 90 percent of the consultants surveyed said that MEP-assisted companies are more knowledgeable of outside consultants than firms that do not use extension services.

NIST LABORATORY PROGRAMS

NIST's laboratory programs have long been recognized for their practical assistance to industry and their focus on infrastructural technologies that support our economy. Our laboratory efforts are planned and implemented in cooperation with industry and focused on infrastructural technologies such as measurements, evaluated data, standards and test methods which provide a common language for use by industry in commerce.

Industry traditionally underinvests in the development of these infrastructural technologies because they are used simultaneously by many firms. These infrastructural technologies typically are not embodied in products, making it difficult or impossible for individual firms or even industries to recover the R&D investment it would take in order to develop these technologies. The benefits from this work are spread across many companies and industries, and the economic impact can be great.

The NIST laboratories operate with a customer base as diverse as U.S. industry itself. They include makers of one-of-a-kind scientific instruments, utilities that supply gas and electricity to tens of millions of commercial and residential customers, software publishers and computer manufacturers, aerospace giants, aspiring biotechnology firms, chemical and food processors, textile manufacturers, makers and users of machine tools, suppliers of steel and concrete, and designers of exotic new materials. Customers range from tiny start-ups to the "Big 3" auto makers and most other companies among the nation's top 100 R&D spending firms.

NIST Laboratories' Progress to Date

Appropriations for NIST laboratories have increased by 37 percent between fiscal years 1993 and 1995 -- the first discernible increases for these critical efforts in decades. These increases have permitted NIST to strengthen our core capability for infrastructural technologies. We have accomplished this without increasing our staff; those who were working to support other agencies' needs have shifted to NIST funding so that they may respond even more directly to industry needs. Also, planning is underway for the renovations and new construction that is vital if the labs are to meet industry's needs in the coming century. I am particularly proud of three accomplishments:

- o We have been able to more aggressively tackle industry's infrastructural technology needs in emerging areas of technology that have grown in the past decade. For example, two areas where we are bringing greater resources to bear in biotechnology and information technologies. Both are clearly huge growth areas for industry, and neither can move ahead easily without the kinds of underlying research and services done by the NIST laboratories.
- o The underlying base for metrology, the science of measurements, has been revitalized. For example, our scientists recently trained an array of four lasers on cesium atoms, trapping and cooling them to within 700 billionths of a degree of absolute zero, the coldest temperature ever reported for an atom measured in three dimensions. This accomplishment eventually may lead to improvements in the accuracy of atomic clocks; each past improvement has led to almost immediate technological applications, from synchronizing telecommunications and electrical power grids to the Global Positioning System.
- o We have broken through years of uneasy relations with our partners in the private sector voluntary standards community, forging new, stronger relationships and bolstering our own standards-related activities. This improved cooperation is critical in light of new international trade agreements and activities. Industry now can count on NIST to deliver more promptly vital standards-related information and services, and to be a better partner in representing U.S. interests in the international arena.

Our laboratories' formal linkages with industry remain as strong as ever. During the past year, NIST entered into 133 new Cooperative R&D Agreements, or CRADAs. Of NIST's 500-plus CRADA partners since 1988, 40 percent have been small businesses, 45 percent have been large or mid-sized firms, and 15 percent have

been universities and other organizations. On average, one technical staff member in five is engaged in a CRADA -- just one indicator of industrial interactions.

NIST Laboratories' Impacts

Several hundred laboratory projects are under way at NIST during a single year. Some relate to the needs of mature industries. Others concentrate on technical challenges confronting emerging industries, and on established high-technology sectors undergoing rapid technological change. All are conducted with industry helping to set the priorities and guiding the work. Most are carried out with industry's active involvement.

Below are several typical projects that give a flavor of how recent NIST laboratory efforts have worked for U.S. industry.

- o Faced with the imminent elimination of ozone-destroying chlorofluorocarbons (CFCs) and the phaseout of related refrigerants, the nation's \$17 billion air conditioning and refrigeration industry now is using a NIST-developed database which calculates key thermophysical properties of 38 refrigerants and mixtures. In the search for cooling systems that are both environmentally and economically acceptable, industry needed high-quality data. An official of the Air-Conditioning and Refrigeration Institute, an industry association, says, "Without NIST, we would have gotten less detailed data, which would have meant a lot more expensive, time-consuming engineering work to produce hardware. It would have cost us millions more."
- o A NIST tool for quickly evaluating the performance of coordinate measuring machines -- used by many manufacturers to check the dimensions of parts and assemblies -- is helping U.S. firms improve their quality assurance methods and cut costs. Manufacturers now can comprehensively assess CMM performance quickly, decreasing the chances that companies will ship poor-quality parts to their customers or scrap good parts mistakenly. Evaluated by Caterpillar Inc. and Boeing, the NIST tool has been commercialized by Giddings and Lewis, a U.S. maker of these measuring machines and machine tools. The product was introduced last year, and already has markets in the aerospace, automotive and heavy equipment industries.
- o NIST recently issued a standard optical fiber that is helping U.S. fiber makers to reduce product variability and greatly improve the likelihood that spliced fibers will align precisely -- ensuring the high quality transmission of signals that their customers expect. An official with

Corning, Inc. reports that this capability has given "Corning and other fiber manufacturers a clear competitive edge."

NIST aims for and expects its infrastructural technologies and services to yield high returns since we expend resources only once to develop, for example, a measurement method that can be used by many companies and frequently for entirely different technologies. Results of an ongoing series of economic impact studies confirm those returns. To date, 8 economic impact studies have been completed, yielding a median rate of return of 167 percent. These returns compare very favorably with those reported in studies of returns on other public investments in technology and on private sector R&D investments.

For example, a recent study shows that through improved calibration services NIST has enabled a tenfold increase in measurement accuracy of watt-hour meters. In turn, that has allowed U.S. electric utilities to more accurately monitor more than \$180 billion of electrical power generated annually, facilitating the resolution of disputes and generating a sizable return to U.S. taxpayers. A new analysis estimates that total benefits exceed costs by a ratio of 41 to 1.

NIST QUALITY OUTREACH PROGRAM

With the cooperation and financial support of the private sector, NIST manages the Malcolm Baldrige National Quality Award, which has become both the U.S. standard of quality achievement in industry and a comprehensive guide to quality improvement.

The award program was established by Congress in 1987 not only to recognize individual U.S. companies for their quality achievements, but also to promote quality awareness and to provide information on successful quality strategies. The major focus of the award is on results and customer satisfaction; it is not given for specific products or services.

NIST has worked closely with a variety of groups to extend the benefits of quality management and stimulate activities nationwide. These organizations range from trade, professional and business groups such as the National Association of Manufacturers, the Council on Competitiveness, and the U.S. Chamber of Commerce, to state and local government organizations and broad-based interest groups like the National Education Association.

Key to this program -- and indicative of its cooperative nature -- is the award's board of examiners. Made up of more than 250 quality experts from many industry sectors, along with a smaller contingent from universities and governments at all levels, board members volunteer many hours reviewing applications for the

award. They have given more than 10,000 presentations on quality management and the award program, helping to spread the message and tools and techniques for improving quality management.

Quality Award Progress to Date

From 1988 to 1994, the award program received nearly 550 applications from U.S. companies. Twenty-two companies, including 11 large manufacturers, five service companies, and six small businesses have won the award. But the program is much more than a contest. Equally important is the award's role in raising awareness by encouraging all U.S. businesses and organizations to implement quality improvement efforts whether they intend, or are even eligible, to apply for the award.

About 1 million copies of the award's guidelines and criteria have been distributed by NIST worldwide, and thousands of organizations are using the criteria as a quality improvement road map. The results of these internal evaluations provide firms with a clear view of where they stand and of how far they must go to achieve world-class levels of quality.

Forty-two state and local quality award programs are operating in 30 states -- most modeled after the Baldrige Award. Many companies participate in these award programs before applying for the national award.

With experts from health care and education, NIST has adapted the Baldrige criteria and framework for these sectors and is launching a pilot program. Pending a successful 1995 trial, continuing support from these two sectors, and funding, full-scale award programs for education and health care could begin in 1996.

Quality Award Impacts

The Baldrige Award program is having a profound effect on how people and organizations operate and work. An independent 1993 study to determine what U.S. business thinks about the award indicated that both industrial and service firms -- large and small -- agreed that the award currently provides the best framework for a total quality management system. The results also showed that the firms surveyed believe the award fosters quality awareness, promotes the understanding of the requirements for quality excellence, promotes sharing of information on successful quality strategies, and recognizes U.S. companies that excel in quality achievement and quality management.

Preliminary results from a more recent survey of U.S. firms conducted last fall by the award's independent advisory group indicated similarly strong support. Seventy-one percent of those 52 companies responding said they used the award criteria as a

quality management assessment tool, and 86 percent said that sharing of practices by Baldrige Award winners has helped to motivate improvements in their own businesses.

Good quality management is no guarantee of business success, but it can lead to outstanding returns -- both for individual companies and for the country. These returns are showing up in increased productivity, satisfied employees and customers, and improved profitability. Recent studies by NIST and others have found that a stock investment in the group of companies winning the award could result in large returns. For example, a hypothetical \$1,000 was invested in the five whole company Baldrige Award winners from the first day the company won the award (or went public) to October 3, 1994. The investment yielded a 188 percent return on investment compared to a 28 percent return for the Standard & Poor's 500, outperforming the S&P 500 by almost 6.5 to 1.

CONCLUSION

The Administration and Congress have expanded the nation's investment in NIST over the past two years while the total level of federally supported R&D has been held steady, or even reduced slightly. The total investment at NIST remains a very small percentage of the government's R&D program. The added investment at NIST is designed to bolster the support companies receive from an agency that has a long track record of working directly with and for industry -- and delivering bottom-line value for taxpayers.

The priorities for our work are industry's priorities. We work in true partnerships with U.S. companies, small and large, to do the jobs that cannot be done separately.

Our major R&D funding effort, the Advanced Technology Program, is enabling technology development that is cost-shared, rigorously competed, and supportive of R&D work, always at the pre-product development stage.

By teaming up with state and local governments, our Manufacturing Extension Partnership is rapidly expanding services to smaller companies throughout the country.

Our laboratories are offering industry the benefits of stronger measurement research and services that underpin companies' R&D, manufacturing and sales.

The Malcolm Baldrige National Quality Award program is beginning to extend the principles of good business practices to our education and health care sectors.

The scale-up challenges for our newer programs, the ATP and MEP, have been substantial. But we have had terrific engagement with industry in both cases. We have ensured that these programs are executed in a manner consistent with NIST's principles of technical excellence and objectivity. We are beginning to see the real fruits of this work, and we look forward to delivering even greater value and positive impacts for U.S. industry, our economy, and our taxpayers.

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DIRECTOR,
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

BEFORE THE

**SUBCOMMITTEE ON TECHNOLOGY, ENVIRONMENT,
AND AVIATION
U.S. HOUSE OF REPRESENTATIVES**

ON

**THE ROLE OF THE NATIONAL INSTITUTE OF STANDARDS AND
TECHNOLOGY IN U.S. TECHNOLOGY POLICY**

JULY 26, 1993

Mr. Chairman and Members of the Subcommittee, I want to welcome you to the National Institute of Standards and Technology and thank you for the opportunity to share some of my thoughts about the future of NIST.

It is appropriate that you have singled out our institution for a special field hearing. NIST is at the center of a shifting approach to the federal role in supporting technology.

Right now, the government is the source for about 45 percent of the \$157 billion invested annually by the United States in research and development. Of that amount, more than half goes for defense, and most of that is devoted to weapons systems development. Fifteen percent of the federal R&D pool supports health. By some accounts, as little as two-tenths of a percent is allotted for "industrial development." (Attachment I) Actually, NIST's appropriations in FY 1993 are just about one half of one percent of the total federal R&D account.

Spurred on by the Clinton Administration, we are seeing a change in that ratio of federal R&D investment which reflects a changing global environment with these key characteristics:

- Global competition has accelerated the rate of innovation. On the negative side, this means that we no longer stand out as leaders in several key industrial technologies. On the positive side, our competitors' aggressiveness and success have forced us to drive innovation at faster and faster rates. When it comes to technological innovation, it is clear that those who don't speed up will fall behind -- and probably by the wayside.
- The end of the Cold War means that we have a tremendous opportunity to redefine our technology investment strategy -- from one based largely on defense and the needs of single-mission federal agencies to an agenda that is geared to the needs of our industries and our workforce.

How is the government responding to these changes?

First, the Clinton Administration is committing to providing long-term growth for the economy and high-quality job opportunities for Americans. A very important part of these efforts is to invest more heavily in civilian technology, with a goal of boosting civilian R&D to account for more than 50 percent of the federal government's total R&D portfolio by 1998.

This commitment is reflected in the President's FY 1994 budget proposals, with NIST as a prime

example and with Commerce Secretary Brown giving top priority to this budget.

Second, our defense expenditures are being driven toward a dual-use technology base that supports our national security in a broader context -- taking into account our economic strength. The Defense Department's Advanced Research Projects Agency (ARPA) plays a key role here.

Third, there is a greater emphasis on transferring technology from government mission-oriented laboratories, such as the Department of Energy labs, into the commercial sector. Some evidence of this trend is the growing number of cooperative research and development agreements that government laboratories are signing with private-sector partners.

At the same time, our overall approach to R&D is changing. We have a clear recognition that being tops in science is not enough. Nor is it enough to be tops in technology-related inventions. We need to be worried most about bringing technology and people together, and moving inventions and innovations into the marketplace -- where they can foster strong industries and new jobs. So where does NIST fit into this picture? We are right in the center of this new technology policy, which is designed to spur economic growth and improve technology development, commercialization, and adoption by U.S. manufacturers. That, in fact, is our primary mission -- something that distinguishes us from any other government institution. NIST is the only federal technology agency with the primary mission of helping U.S. industry to improve its international competitiveness.

Unlike any other federal research organization, NIST has more than 90 years of experience:

- collaborating directly with industry researchers;
- tailoring its programs to meet industry needs;
- working internationally to advance U.S. industry's interests in standards-related matters; and
- anticipating the technology "infrastructure" by conducting measurement research needed for developing and commercializing the next generation of commercial technologies.

Congress -- your predecessor subcommittee, in fact -- laid the foundation for expanding this work in 1988 when the National Bureau of Standards was transformed into NIST. You gave us the explicit mission and expanded assignments that now are beginning to take hold and to bear fruit.

NIST has many mechanisms and tools -- some old, some new -- to meet many types of industry needs. We facilitate standards, serve as an honest broker in R&D, reach out to small and medium-sized manufacturers, and fund specific technology projects with companies. This richness of approaches is essential to tackle the complex challenges ahead. Underlying all of NIST's work is one common theme: a focus on industry's needs supported by many, many interwoven links to companies. This culture can be traced back through NIST's history as a laboratory, and it was one of the key reasons for establishing the extramural programs here.

There is one especially important ingredient critical to NIST's success in the years ahead, and fortunately, we have it in abundance: a dedicated staff of outstanding people with superb technical quality who work in an atmosphere of respect and commitment to a larger purpose. We can have all the "right" programs in the world, but they will not be effective without the "right" staff. It is my firm view that managing through smart, ethical, empowered people is the only way to tackle the complex job that lies ahead -- and NIST is especially well-equipped. The Clinton Administration has proposed that NIST receive a major infusion of new funds so the Institute's programs can make good on their tremendous potential. I believe the President's technology plan heralds a new era for an agency with a proud 92-year history. This confidence in NIST is a testament to the Institute's record of close ties to industry, the sound beginnings of the Advanced Technology Program and the Manufacturing Extension Partnership, and our program to foster leadership in quality. It also is a testament to this committee's vision and long-standing support for NIST.

It is appropriate that you have asked an official from the National Institutes of Health to appear today, because NIH was one model that Congress had in mind when NIST was renamed and its mission was expanded. NIH has demonstrated that laboratory programs can be combined with extramural funding

programs to effectively help achieve national goals.

The Defense Department's Advanced Research Projects Agency (ARPA) has had tremendous success in leveraging investment and fostering competitiveness for industries critical to defense, making it another kind of model. I know how ARPA "moved mountains," having spent several years charged with doing just that at the agency.

Now, NIST is ready to take on a similar task for U.S. civilian companies, benefiting from the experiences at both NIH and ARPA -- but especially from our agency's own solid base of accomplishments and a reputation for scientific excellence, quality, and linkages with industry.

I would like to explain briefly our approach and plans. The accompanying chart indicates how this institution will change. (Attachment II)

Advanced Technology Program

The Advanced Technology Program is a flagship program in the President's technology vision. Through a rigorous, competitive process, NIST has demonstrated that the ATP can leverage industrial research and development funding from companies and joint ventures of all sizes. The goal is to develop high-risk technologies that have substantial commercial applications but are still in the precompetitive stage. In the first three competitions, the ATP committed to nearly half of a \$400 million technology development effort being undertaken by U.S. industry. Thus far, ATP has funded 60 projects carried out by more than 120 companies around the country. A new round of awards will be announced in about a month.

The early signs of success are encouraging. ATP funding is already shortening the time to market for its recipients. The program has begun to help some defense contractors to apply their products to commercial markets. I would like to submit for the record a report indicating some of the progress made from the first round of competitions. This report reflects the initial recipients' perspectives on the program.

The President's technology plan expands funding for the ATP to \$750 million by FY 1997. We have a solid base to build on. The ATP is a competitive process, with both technology and business plans assessed to increase the chances for success and decrease the risks. Only industry receives direct funding, although universities can participate in projects. Costs are shared with industry. Projects are selected not because any interest group comes to Washington seeking support; the process is free of political influence. The ATP program incorporates a process that reflects industry's ideas and industry's focus on the technologies that can be expected to have significant commercial impact.

The expanded ATP will maintain the advantages of the current program and allow a much larger number of firms to participate. It will broaden and deepen the program's ability to leverage private-sector R&D funding, accelerating the commercialization process for many more companies.

Expansion also will allow us to create programs within ATP that are focused on specific technology goals, alongside the present general competitions. A program within ATP will consist of a collection of awards, similar to those currently under way, that are managed with a strategic focus so that the effect is greater than the sum of the individual parts. Thus the basic unit of work will be a program, rather than a single award. As with the individual awards, we will look to industry for the most compelling opportunities for programs in ATP. Selection criteria will include the potential for contributing to U.S. economic growth; high-quality, challenging technology ideas that can affect the program area; the breadth and depth of U.S. industry's interest; and the need and potential for ATP funds to "make a difference." Over the next few years, ATP will consist of a collection of programs -- each roughly \$20 to \$50 million per year over five years -- plus a set of general competitions that continue our present mode of operation. This more focused approach will lead to an ATP that is a powerful tool to help U.S. industry drive advanced technology for competitiveness.

Manufacturing Extension Partnership

In A Vision of Change for America, President Clinton described his intention to establish at NIST a program with "over 100 manufacturing extension centers nationwide by 1997 to assist manufacturers to modernize their production capability." This program, which we have planned as the Manufacturing Extension Partnership (MEP), builds on the tested approaches of the NIST Manufacturing Technology Centers (MTCs) and our State Technology Extension Program. The plan also includes Manufacturing Outreach Centers, which are smaller in scale, more numerous, and intended to serve regions with lower concentrations of manufacturers.

We envision the MEP as an integrated, nationwide network of organizations to support American manufacturers in increasing their competitiveness nationally and internationally through technological advancement. The network will provide seamless, coordinated services to small and medium-sized manufacturers that rely heavily on local management.

Like the ATP and the MTCs, the MEP is a merit-based competition, with only the best proposals receiving our funding support. Proposals are evaluated on the proposers' knowledge of target firms in the region, technology resources, technology transfer mechanisms, and management and financial plans.

We believe that the goal of establishing more than 100 extension centers by FY 1997 allows NIST to build the MEP smoothly and to maintain the high-quality standards the program now enjoys. ARPA's Technology Reinvestment Project of defense conversion funding and dual-use technology deployment will provide a jump-start for the MEP, supporting centers that will mesh smoothly with our plans for the program. NIST expects to manage the TRP-funded centers selected through the interagency process, ensuring a good match of these projects with the NIST-funded centers.

Quality Outreach

Few, if any, government programs have attempted to achieve the kind of success and partnership with the private sector that the Malcolm Baldrige National Quality Award has demonstrated in just five years. Established to promote quality awareness, to recognize quality achievements of U.S. companies, and to publicize successful quality strategies, the award is having a major impact in encouraging large numbers of U.S. companies to adopt quality improvement strategies -- whether or not they ever decide to compete for the award. These corporate strategies are improving the ability of U.S. companies to compete in a more important and larger contest: winning in the global marketplace.

Building on the award program and the institution's reputation for helping industry to improve quality in very practical ways, NIST intends to expand the quality awards program through more aggressive outreach and information dissemination, and through research on how quality principles and programs can help businesses and research institutions. We also plan to link up more closely with the education and health care communities as they focus more intently on applying quality principles to their operations. NIST can and must help more companies and other organizations to strive for new standards of quality excellence.

Laboratory Programs

It is NIST's laboratory programs that have given the agency its solid reputation for assistance to industry. The non-profit Council on Competitiveness said recently that NIST's process for working cooperatively with industry is "the most streamlined of all and is perhaps the best model for other federal labs to follow.... NIST is very flexible and able to respond quickly to industry's inquiries without bureaucratic interference." This culture of cooperation is reflected in the very large numbers of cooperative research and development agreements, or CRADAs, that we have established with companies and other organizations: approximately one CRADA for every six NIST scientists and engineers. (Attachment III) But we look way beyond CRADAs, and it is equally or more important to look at our informal collaborations with, and assistance to, industry. We don't need a formal agreement in order to help a U.S.

company.

NIST's laboratory programs represent the technology infrastructure necessary to help U.S. companies win on the economic playing field. The generic technologies, measurement methods, standards, and processing improvements provided by NIST programs represent essential "roads and bridges" to world-class industrial competitiveness. U.S. companies need these technologies and services to create new products, improve the quality of existing ones, and upgrade manufacturing and service efficiency.

Detailed economic studies conducted by independent research groups for NIST have documented high rates of return for investments in NIST laboratory research. I am attaching to my testimony a summary of impacts from both our laboratory and our extramural programs, which offers several examples. (Attachment IV) There are scores of additional instances in which NIST's laboratory programs have made a competitive difference for U.S. firms.

You will be hearing from Dr. Hratch Semerjian, director of the NIST Chemical Science and Technology Laboratory, who will provide details on another vital aspect of our laboratory work: research and services that help improve public health and safety as well as the environment. These are NIST efforts that become even more important as society recognizes the links between a healthy and safe citizenry and a workforce ready to compete with the world's best -- and as our nation strives to meet the dual goals of environmental and economic progress. Despite our laboratories' effectiveness and industry's demand for greater levels of research and services, funding for these programs has been virtually flat since the early 1970s -- a period during which overall government and industry R&D budgets almost doubled in real terms. I have attached a chart which graphically illustrates that pattern. (Attachment V) This is a pattern which must be broken -- and the Clinton Administration's technology plan calls for a dramatic break with the past. The President and Commerce Secretary Brown are supporting increases that put us on track for doubling our direct funding for laboratory-based research and services over the next four years.

We also have received a commitment from the Administration and Congress for a sorely needed effort to update our research facilities in Gaithersburg and in Boulder, Colorado. World-class research cannot be conducted in laboratories that are aging and falling quickly behind the capabilities of our international competitors. We are limited in our ability to control temperature, humidity, vibration, and air cleanliness -- all of which were more than adequate when these buildings were constructed a few decades ago. These limitations already have made it impossible to provide some U.S. manufacturers with essential services, such as state-of-the-art calibrations urgently needed to maintain production-line quality controls on a par with Japanese and European competitors.

It is vital that NIST laboratories receive the funding that we have requested to update our facilities and to support our research work. This is especially true in light of the history of high levels of funding to NIST from other government agencies. (Attachment VI). NIST must always be ready to serve other agencies that require our special expertise and neutral, third-party role. But I believe firmly that this institution must take greater control over its own priorities in light of our position as the only federal technology agency devoted primarily to improving U.S. industrial competitiveness. That means that we must receive a greater share of our funding from direct congressional appropriations as we move through the 1990s.

I consider it essential that our laboratory efforts be strengthened at the same time that our extramural programs are receiving increasing support. The laboratory programs fill a fundamental need of U.S. companies that cannot otherwise be met. They also provide us the basis for technical expertise that is so important as we expand the Advanced Technology Program, the Manufacturing Extension Partnership, and quality awards and outreach programs.

Conclusion

Mr. Chairman, I trust that I have given you some insight into the approach that we plan to take at NIST to move this agency into the forefront of our changing federal technology efforts. We intend to strike a

balance among the variety of excellent tools we have for meeting U.S. companies' needs in strengthening their international competitiveness. Obviously, we expect that the NIST of 1997 and beyond will be different from the agency that you are looking at today. But most importantly, Mr. Chairman, I assure you that we intend to succeed by following NIST's proven record of technical excellence, impartiality, and success in linking up closely with U.S. industry in every way possible.

Thank you, and I would be happy to answer any questions you may have.

Statement of

Arati Prabhakar

Director
National Institute of Standards and Technology

Before The

Subcommittee on Technology, Environment and Aviation Committee on Science, Space and Technology U.S. House of Representatives

July 20, 1993

Mr. Chairman, and Members of the Committee. Thank you for inviting me here today to talk about NIST activities that are aimed at stimulating the economy and in particular, our participation in the Technology Reinvestment Project (TRP).

Mr. Chairman, with the end of the Cold War we are faced with a major shifting of priorities for our country from a focus on national security to a focus on our economic security and the health and competitiveness of our industry. To accomplish this we must undertake a national effort to bring about a fundamental change in our industrial base. However, this will not be an easy task to accomplish.

The changes in the global situation today are placing unprecedented demands--from customers and from increasing competition around the world--on our civilian industry. These forces are pushing our manufacturers to deliver low- cost, high- quality, differentiated, and even customized products. And at the same time, these forces demand that new products be introduced more rapidly and that new, stronger relationships be forged between suppliers and customers in the manufacturing chain.

The federal government must look to its role. Over half of the dollars invested in government research and development today are for national security. While preserving a strong national defense base, we must invest in R&D to help our industries function more efficiently and effectively and compete in a global marketplace.

The President and this Administration and particularly Secretary Brown and this Department of Commerce are committed to providing long-term growth for the economy and high-quality job opportunities for the American people. A very important part of the Administration's efforts to promote long-term economic growth is increased investment in technology to meet U.S. industry's needs. We can use technology to revitalize our manufacturing sector, and we can help create an environment in which industry can bring new technology to market and compete effectively.

There are many parts to the federal response to these new challenges. The Administration is:

- increasing the emphasis on dual-use technologies in DOD;
- trying to make greater use of the technologies in our national laboratories;
- increasing the federal investments for civilian technology.

Mr. Chairman, we appreciate the critical support you and the Science Committee have given to NIST as we move ahead in meeting this challenge. The passage of the Technology Competitiveness Act of 1988 and your continuing efforts in support of our intramural and extramural programs have laid the foundation for the work ahead.

NIST has three approaches or programs to tackle the civilian technology challenge: the Manufacturing Extension Partnership (MEP), the Advanced Technology Program (ATP), and NIST laboratory efforts.

While each has a clear role in meeting industry's needs during this period of economic restructuring, today I want to focus on MEP. Let me begin by telling you about our participation in the Technology Reinvestment Project.

Technology Reinvestment Project (TRP)

The Technology Reinvestment Project (TRP) is one piece of the national defense conversion effort. TRP's mission is to stimulate this transition to a growing, integrated, national industrial capability which provides the most advanced and affordable military systems and the most competitive commercial products. TRP programs are intended to help create high-quality, high-wage jobs for American workers in commercial and dual-use U.S. industries, and to enhance U.S. competitiveness.

The Advanced Research Projects Agency (ARPA) is doing an excellent job of managing the TRP. Under ARPA's leadership, the Department of Commerce's National Institute of Standards and Technology (NIST), the Department of Energy/Defense Programs (DOE/DP), the National Science Foundation (NSF), and the National Aeronautics and Space Administration (NASA) signed a memorandum of understanding which forms the Defense Technology Conversion Council. NIST participated as a Council member in developing selection criteria, and is participating in the selection of proposals to implement the TRP.

NIST has two roles in ARPA's TRP effort. For the development activities under TRP, NIST will provide technical experts to assist ARPA in the review of proposals.

The TRP deployment activities are based on the strengths of NIST's Manufacturing Technology Centers program and are structured to be consistent with NIST's Manufacturing Extension Partnership. We plan to play a major role in the deployment activities. We are working closely with ARPA and with the DoE national laboratories, NASA technology transfer centers, DoD centers of excellence and laboratories, and related activities throughout government on this effort.

The Manufacturing Extension Service Providers portion of the TRP consists of \$87.4M. In addition, we have some other activities in the technology deployment category. Based on the number of strong proposals expected, NIST estimates that awards will be given to 5 entities similar to the Manufacturing Technology Centers, 25-30 entities similar to the Manufacturing Outreach Centers, and a substantial number of State Technology Extension Program-like projects. We anticipate that the expenditures under the TRP will be spread over two years.

NIST Manufacturing Extension Partnership (MEP)

In Vision of Change for America, accompanying his State of the Union message, President Clinton described his intention to establish at NIST a program with "over 100 manufacturing extension centers nationwide by 1997 to assist manufacturers to modernize their production capability." This program, which we have planned under the name Manufacturing Extension Partnership, builds on the foundation of tested approaches developed by our Manufacturing Technology Centers and State Technology Extension Programs. The plan also includes Manufacturing Outreach Centers, which are smaller in scale, will be more numerous and are intended to serve regions with lower concentrations of manufacturers.

NIST, in cooperation with others, is now implementing this national program to modernize America's manufacturing base. The Partnership seeks to mobilize existing sources of manufacturing technology, advanced manufacturing practices, and business assistance and link them to state and local assistance-providers and U.S. manufacturers via nationwide networks. By FY 1997, NIST intends to have in place over 100 centers, along with active STEP grants and linkage activities. We believe the goal of 100 centers by FY 1997 will allow us to maintain the high quality the program now enjoys.

The Manufacturing Extension Partnership has four major components:

Manufacturing Technology Centers

The Manufacturing Technology Centers program was created by the 1988 Omnibus Trade and Competitiveness Act to improve the competitiveness of U.S. based small and medium sized manufacturers through advances in their levels of technology utilization. Since 1988, seven Manufacturing Technology Centers (MTCs) have been established in Cleveland, Ohio; Albany, New York; Columbia, South Carolina; Ann Arbor, Michigan; Kansas City, Kansas; Minneapolis, Minnesota; and Los Angeles, California. Over 6,000 firms have participated in MTC activities. Hundreds of small and medium sized companies have benefited from in-depth assessments of their manufacturing and business operations, and thousands have participated in workshops and seminars. Many collaborations have resulted in the licensing of federal technologies, the designing of new processes, and the introduction of new products into the market.

Manufacturing Outreach Centers

The outreach centers are intended to provide services in areas of lower manufacturing concentration (as free-standing centers) or to extend the effective reach of the MTCs (as satellites to an MTC). They will, in most cases, be run by established institutions: technical colleges, state technology extension services, and other non-profit technology transfer organizations. The manufacturing outreach centers will be the principal entry points for the companies served by the Partnership.

State Technology Extension Program

The State Technology Extension Program (STEP) provides technical assistance and funding to states for planning and implementation of state-based industrial extension infrastructure. Since 1989, 34 states have participated in the program. By 1997, the STEP expects to establish relations with all 50 states.

A system of linkages, or "LINKS"

This system takes two forms. First, a network system to link all of the modernization service providers and the sources of technology. This will use existing hardware networks and new network facilities developed outside the program. The Partnership will overlay the information management systems necessary for its services. Second, MEP actively recruits and coordinates participation by all federal agencies which have programs related to manufacturing -- this way America's small manufacturers can be provided with the "one stop shopping" they require.

Conclusion

The changes in the global situation today are placing unprecedented demands on our economic structure. The dislocations caused by the restructuring of our defense industry are just part of the deeper forces of increased international competition, the rise of world markets, and the accelerating pace of technology. To meet these challenges will require a new culture of cooperation and partnership. We need new, stronger relationships between suppliers and customers, between government and industry. With the Manufacturing Extension Partnership and our other technology programs, we intend to build some important, effective elements in this mosaic.

Thank you, Mr. Chairman. I will be happy to answer any questions you may have.

Statement of

Cita Furlani

Program Manager, Enterprise Integration
Computer Systems Laboratory
National Institute of Standards and Technology

Before The

Subcommittee on Technology, Environment, and Aviation

and the

Subcommittee on Science Committee on Science, Space, and Technology U.S. House of Representatives

May 26, 1994

Introduction

Mr. Chairmen and Members of the Committee, thank you for inviting me here today to represent the National Institute of Standards and Technology (NIST) to testify on Electronic Commerce and Interoperability in the National Information Infrastructure. Dr. Arati Prabhakar, Director of NIST, chairs the Committee on Applications and Technology within the Information Infrastructure Task Force. Our Secretary, Ron Brown, chairs that larger task force.

The Information Infrastructure Task Force is an Interagency Administration team implementing the President's action plan for developing, in partnership with the private sector, an advanced information infrastructure -- the National Information Infrastructure (NII). This team is helping to shape a vision of the NII and bring that vision closer to reality.

The National Information Infrastructure

As an interconnection of computer, telecommunications, entertainment, wireless, and other networks, services and applications, the NII has the potential to significantly improve the way people use information in their jobs and other aspects of their daily lives by bringing vast amounts of information and greatly improved services to virtually every citizen. The current focuses of the information technology national challenges are the application of information technology in theories of electronic commerce, manufacturing, education, healthcare, government services, libraries, and the environment. But it is critical that the user does not have to worry about boundaries or translations - only the task at hand; that the user perceive and have access to a transparent, interoperable, and seamless NII.

Secretary Brown has said: "There's going to be a fundamental change in the way we work, the way we learn, the way we communicate. Knowing how the Industrial Revolution permanently altered American life, we can only begin to imagine how we will be transformed by becoming an information society."

The National Information Infrastructure is not a cliff which suddenly confronts us, but rather a slope and one that society has been climbing since postal services and semaphore networks were established. An information infrastructure has been with us for a long time, continuously evolving with each new advance in communications technology. Why the sudden debate?

Change is coming much faster, and more thoroughly, than ever before. In our lifetimes we will see information technology bring more changes to more aspects of our daily lives than have been witnessed in the preceding century. We are at an exciting juncture as a technology revolution is transformed into a capability revolution. Digital technology is merging the functions of television sets, telephones, and computers. Positive fundamental changes are in store for us in the ways we manufacture, work, learn, shop, communicate, entertain ourselves, and receive health care and public services. And those are just the applications we can foresee.

Private industry will be responsible for virtually every major facet of the NII and the information marketplace it creates. Private industry will build and manage the networks, provide the information tools and most of the information that travels the networks, and develop most of the applications that use the networks. Indeed, a constant theme throughout the work of the Information Infrastructure Task Force is the on-going dialogue not only with industry but with all of the private sector, including public interest groups.

But government remains a major force with respect to the NII. One reason is obvious government policies are a major factor in the information infrastructure; for instance, deregulation of telecommunications. In addition, government is a major user of information technology and a major contributor to the development of information technology.

One of the principal goals of the Information Infrastructure Task Force is to develop and foster informed government policies that promote our societal goals for the NII without hampering industry. As Vice President Gore has observed, "Our goal is not to design the [information] market of the future. It is to provide the principles that shape that market. And it is to provide the rules governing this difficult transition to an open market for information. We are committed in that transition to protecting the availability, affordability and diversity of information and information technology as market forces replace regulations and judicial models that are simply no longer appropriate."

Less obvious than the role in telecommunications, however, is the fact that government plays a major role in the development of NII applications as one of the nation's biggest users and producers of information. The government develops NII applications to speed and improve the delivery of its services. Examples include making social security payments by computer or disseminating census data.

In addition, government research agencies play a national role in research and development (R&D) for the information infrastructure, emphasizing R&D that is too big for one company to do or too broad for one company to fully realize their investment, i.e., work that no one wants to do, but which benefits everyone.

This research often includes the development of prototype applications as a proof of concept or to help speed the development of useful applications by the private sector. Examples include R&D on advanced medical information applications, work on NII tools for educators, and research on advanced manufacturing applications using computer networks.

Committee on Applications and Technology

The Committee on Applications and Technology of the Information Infrastructure Task Force was created in part to provide a forum for discussing and coordinating the host of applications efforts across the Federal government. So pervasive is the NII and the issues it represents that virtually every department and function of government is involved.

The Committee's goal is to encourage Federal researchers working on NII applications to view their work in the greater context of the NII as a whole, and to: promote the sharing of information to enhance coordination among Federal agencies developing NII applications; highlight opportunities for cooperative efforts between Federal agencies and between government and industry; and promote discussion of critical technical and social issues in the development of the NII that affect the development and use of advanced NII applications. Viewing the development of the NII from an

applications perspective is important for the lessons we learn about the practical effects of complex issues such as intellectual property rights, privacy, and equitable access. Such issues frequently require technical solutions as well as changes in policy. Building applications for real users is a powerful tool for rooting out the bugs in the system and for promoting the development of products and electronic highways by industry.

Most importantly, to realize the vision, applications must be able to use the same infrastructure. Taking a view of many applications at once enables us to avoid application-specific solutions and to better define the requirements that a National Information Infrastructure must meet. The creation of an advanced infrastructure that can support all applications requires solutions to many technical, legal, security, financial, and regulatory barriers, as well as the widespread adoption and use of a variety of technical standards for communications, information processing, and security. Such suites of standards as Electronic Data Interchange (EDI), Standard for The Exchange of Product model data (STEP), and Open Systems Environment (OSE) are critical to the development of such an advanced infrastructure.

National Information Infrastructure Applications Report

To stimulate public discussion of how people and organizations use the information infrastructure, the Committee on Applications and Technology has prepared a report entitled *Putting the Information Infrastructure to Work*. This report, comprised of individual applications papers, explores some of the opportunities and obstacles in seven key applications areas of the NII. We identified these as the core set because there are significant public interests to be served by the application of advanced information and communications technologies in these arenas and some key government activity is already underway.

This report was released as a draft for public comment on May 4, 1994, by Secretary Brown, who stated that "we are releasing these papers because it is not enough to discuss how information highways will be built; we must also understand and inform Americans about how they will be used. These papers focus on the real-life concerns of people who will rely on information technology."

The visions in each application area were authored by members of the federal agencies with a close tie to the area. However, given the broad scope of agency involvement, every paper is representative of the cooperation fostered by the Committee's activities, with contributions from many agencies. The agencies of the authors characterize this diversity:

Electronic Commerce

Chuck Chamberlain (United States Postal Service) and David Jefferson (National Institute of Standards and Technology)

Manufacturing

Mark Mandell (National Institute of Standards and Technology)

Health Care

Michael Fitzmaurice (Department of Health and Human Services)

Education

Linda Roberts (Department of Education)

Environmental Monitoring

Ernest Daddio (National Oceanic and Atmospheric Administration)

Libraries

Herb Becker (Library of Congress)

Government Services

Jasmeet Seehra (Office of Management and Budget)

Coordinator

David Lytel (National Institute of Standards and Technology)

The report describes a national vision for each of the seven application areas as to how the evolving NII can:

- increase the speed and efficiency of business-to-business communication, or electronic

- commerce, to promote economic growth;
- enhance the competitiveness of our manufacturing base;
- improve health care delivery and control costs;
- promote the development and accessibility of quality educational and lifelong learning for all Americans;
- make the nation more effective at environmental monitoring and assessing its impact upon the Earth;
- sustain the role of libraries as agents of democratic and equal access to information; and
- provide government services to the public faster, more responsively and more efficiently.

The topics presented in the document explore these areas as a stimulus for further debate. In addition, this document describes relevant work in the private sector and in government for each application area. It is intended for four important audiences: the general public, the private sector organizations that are building the NII and driving its applications, the committees and working groups of the Information Infrastructure Task Force, and other agencies and departments in our Government. There are many other relevant applications of the NII. Additional applications will be explored in subsequent reports.

Sections of the papers are presented as questions, and we have publicly solicited help in answering these questions and raising other relevant issues. Those responses will illuminate and guide government policies and investments to accelerate NII applications.

Electronic Commerce and the National Information Infrastructure

Most pertinent to today's discussion is the paper on Electronic Commerce. An advanced NII that supports Electronic Commerce applications will provide benefits in a number of areas: reduced costs, reduced errors in information processing, creation of new markets, better quality and variety of goods, and reduced time to market. An advanced national Electronic Commerce capability will be comprised of interconnected communications networks; advanced computer hardware and software tools and services; established business transaction, data exchange, and interoperability standards; accepted security and privacy provisions; and suitable managerial and cultural practices.

This infrastructure will enable diverse and distributed companies throughout the nation to rapidly, flexibly, and securely exchange and, more importantly, use information to drive their business processes. As a result, people who are needed to creatively solve complex business problems can be taken out of the loop of routine data processing.

All over the government, agencies are beginning to adopt Electronic Commerce for the very high volumes of information interchanges required in their tax, insurance, procurement, and regulatory activities. Implementation of Electronic Commerce by the federal government, including its adoption of applicable national voluntary standards, has provided and will continue to provide significant momentum towards implementation nationwide.

For instance my own agency, the National Institute of Standards and Technology, has been active in research and development for Electronic Commerce as well as in efforts to increase public dialogue on Electronic Commerce and standards issues. NIST assists the private sector with the development of the technical underpinnings for interoperability, and also works to coordinate and facilitate the standards process. Other NIST activities include the establishment of an Electronic Commerce Integration Facility (ECIF) to assist in the removal of barriers that are currently preventing the transition from paper-based commerce to Electronic Commerce, and to help advance technology in order to permit the development of future Electronic Commerce applications.

Standards

The nature of Electronic Commerce requires cooperation and flexibility among permanent and transient

partners, and development of a national electronic marketplace which is secure, open, affordable, easy to access, and easy to use. This in turn requires the establishment of standards for the interoperability of communications networks, information and data exchange, and security services.

The Committee on Applications and Technology has responsibility for addressing the issue of standards, an issue that cuts across the work of all the committees of the Information Infrastructure Task Force. The acceleration of information technology and user preference for multi-vendor equipment is forcing the need for worldwide standardization for components of the information infrastructure.

The private, voluntary standards system is still the best approach for the U.S. economy. However, the standards making process can be slow due to market share protection, strict consensus rules for voting, and openness to all interested organizations. Better cooperation and communication is needed among standards organizations, industry, and government to make this system work more effectively in this time of rapid technological change.

The government's role is to promote the use of standards through purchase of products and through incorporation into Federal regulations where appropriate; to provide the technical underpinning for standards; to encourage international trade activities; and to advocate for the U.S. national interest.

With this in mind, one of the working groups within the Committee on Applications and Technology has been tasked to: identify the processes (especially best practices) being effectively used by the various stakeholders to develop and implement de facto and de jure standards; identify the key interfaces to standardization which would enable the existing and emerging information infrastructure for the communications, computing and entertainment arenas to seamlessly operate; and identify how the government will describe appropriate information infrastructure standards selected for use when purchasing.

In short, the government must be a better partner in the whole standards process. Our focus is on working with the private and public sectors to develop a systems approach to the standards process to achieve national goals more effectively; to clarify responsibility of and relations among industry companies, standards organizations, technical societies, and the government within the standards process; and to strengthen communication among all parties to improve the voluntary system.

Summary

The government's role is to set the rules for competition and enforce them, ensure that improvements in public communication benefit all Americans rather than a select few, promote the adoption of standards that allow systems to interoperate, work with the private voluntary standards system as a partner, support research to improve information systems and make them easier to use, be a wise purchaser of information technologies and services, make use of information technology to better serve the citizen, and reduce uncertainty and risk by funding pilot projects that demonstrate the usefulness and economic efficiency of new services and applications.

The computers, networks, standards, interoperability, accessibility, training, and other components of the NII are the raw materials used to build a national Electronic Commerce capability. Once the tools for Electronic Commerce are nationally available and companies are comfortable using them, organizations will be able to concentrate on a re-examination of business processes rather than working to overcome technology barriers. As a result, the realization of the benefits possible through Electronic Commerce will be accelerated by implementation of the NII.

The Committee on Applications and Technology, along with the entire Information Infrastructure Task Force, will continue to work to enable the government to be a better partner in a national effort to establish the NII.

This completes my testimony. To provide you with more detail, I am attaching a copy of our Committee's report Putting the Information Infrastructure to Work. I will be pleased to answer any

questions the Committees may have.

Thank you.

Statement of

Dr. Curt W. Reimann

Director
Office of Quality Programs

National Institute of Standards and Technology, Technology Administration

Department of Commerce

Before the

Subcommittee on Technology, Committee on Science

U.S. House of Representatives

on The Malcolm Baldrige National Quality Award Program: An Oversight Review From Its Inception

October 18, 1995

Madam Chairwoman and members of the Committee:

I am Curt W. Reimann, Director for Quality Programs at the National Institute of Standards and Technology. I am pleased to appear before you today to participate in a review of the Malcolm Baldrige National Quality Award Program that could help shape its future. This review is timely, as the Award Program has just completed its eighth year of operation. There is much we have learned that is crucial to this review. My comments today will highlight key developments, observations, and conclusions, with a special focus on factors that bear upon the central guiding purpose of the Award: to improve the competitiveness of the United States. I will not attempt to make this testimony a history, but I will draw upon experiences and trends that relate in a clear way to fulfilling the purpose that led to your creation of the Award in 1987.

I begin on a personal note. It has been my privilege to direct the Baldrige Award Program since the Award was signed into law in August 1987. During that time, Awards have been presented by Presidents Reagan, Bush, and Clinton. The Program has received the enthusiastic backing of Commerce Secretaries Verity, Mosbacher, Franklin, and Brown. When President Clinton and Commerce Secretary Brown presented the Awards in 1993, seated in the front row were former Secretaries Verity, Mosbacher, and Franklin -- President Reagan and President Bush appointees. This was a very important highlight in the Baldrige Award Program. This Committee has always shown strong interest in the Award, and this interest now continues with the change in Committee leadership. The Baldrige family has given constant encouragement and warm support, beginning with a visit to NBS (now NIST) by Mrs. Baldrige almost eight years ago. Mr. Robert Baldrige, Malcolm Baldrige's brother, has been a director of the Baldrige Award Foundation since its inception. I make this point regarding broad involvement, support, and interest over eight years not only to express appreciation. I do so to emphasize the fact that the Baldrige Award Program has been, and remains, non-partisan. The Award's processes have been free from partisan, political, or other influences -- by careful design and by eight years of practice and constant refinement.

I understand, of course, that although this review is primarily concerned with the progress we are making in fulfilling the purposes of the Baldrige Award, the review must also consider the resources required, particularly federal expenditures. However, the situation regarding resources and federal

expenditures has turned out to be far more complex than envisioned in the Malcolm Baldrige National Quality Improvement Act of 1987. The reason for this complexity resides in the nature and broad scope of problems addressed by the Act. Also, the number, type, and diversity of U.S. institutions presents many challenges. We need to understand what they are able to do, and when, why, and how they contribute to national efforts.

The Award policy and management questions, and the related resource questions, then, pose new and difficult challenges regarding the best combination of resources --bearing in mind the purposes of the Award and the goals and roles of institutions. In my view, the right answer must be appropriate theoretically (proper roles of public and private institutions) and pragmatically (how to maximize and balance the "right kinds" of resources) to make effective and rapid progress.

The picture I want to present today is how we have shaped the Baldrige Award Program, building upon the considerable strengths of the enabling Act, and working to overcome the Act's limitations. In particular, I want to convey my view of what the important resources are in this national effort and how we are working to maximize private sector and public sector volunteerism, participation, and contributions. I will emphasize also that working on such a significant and broad purpose as improving national competitiveness, with an award as the only vehicle, creates numerous strains and distortions that inhibit more rapid progress. We need to find some way to overcome this limitation. The Council on Competitiveness' recommendations -- presented by Mr. Stata today -- make a number of proposals based on careful consideration by leaders from business, labor, health, and education. These recommendations were endorsed by the leadership of the Council.

Turning now to the key stages in the history of the Award -- those related to getting started.

Establishing the Intent of PL 100-107

During the early months of the Award's implementation, Dr. Ambler, then Director of NBS, Ray Kammer, Deputy Director, and I spoke with members of Congress and staff regarding the intent of the law. We also spoke with Mr. John Hudiburg, then CEO of the Florida Power and Light Company (FPL), and members of his staff, because of the central role they had played in formulating and supporting the legislation. A number of recollections stand out clearly from these discussions:

- There were mounting concerns regarding the U.S.' declining competitiveness. We need to act, not just contemplate the decline, was the concern voiced by many.
- There was firm conviction that the Baldrige Award should set a very high standard. To succeed, the Award must be credible in every sense.
- There was strong belief that the Award should be a means to competitiveness improvement, not an end. That is, the purpose of the Award is threefold: building awareness, recognizing leadership, and sharing best practices information. Success would depend upon whether or not sharing actually occurred. Although some concern was expressed about whether winners would be willing to share, little concern was voiced about how a small number of winners could be expected to reach and to influence millions of organizations.
- The distinctions made in the law through the use of terms such as "companies", "organizations", "public sector", "accept gifts from public and private sources", coupled with the authority given to the Secretary to create new categories, were universally taken to mean that the Award should eventually be open to all organizations, public and private, profit and non-profit. Beneficiaries of the learnings from the initial business Award, however, are clearly intended to be organizations in all sectors.
- Success of the Baldrige Award effort would depend upon creating and expanding partnerships. Concern was expressed by some that the Federal Government would need to be a full partner, and that such a role would require that the government learn to operate effectively in diverse communities. NBS (now NIST) was selected to manage the Baldrige Award not only because of

expertise in the quality sciences but also because of its reputation for impartiality and its close ties to business and professional communities. Some also noted that many of the communities to be included were fragmented and contentious, a concern brought to light during the period when the legislation was pending.

Launching the Baldrige Award Program

In October 1987, we presented NBS' (now NIST) concept plan for the Award to Commerce Secretary Verity, successor to Malcolm Baldrige. Elements of this plan had been presented to business and professional society leaders in September and early October. Mr. Verity was extremely supportive and clearly committed to having the Baldrige Award become an effective instrument in improving national competitiveness. He explained that in preparing to assume his duties as Secretary, many friends and colleagues had impressed upon him the importance of strengthening national competitiveness, and the opportunity presented to the Commerce Department by the Malcolm Baldrige National Quality Improvement Act of 1987. Mr. Verity also explained that the Reagan Administration was committed to presenting the first Awards during Mr. Reagan's term of office. The target date was set for November, 1988. From this target date, we determined that initial criteria, evaluation processes, and a wide range of start-up requirements had to be met by very early 1988.

Secretary Verity then asked Mr. John Hudiburg and Mr. Sanford N. McDonnell -- both supporters of the national award concept - to lead the creation of a foundation to raise funds to help support the Award Program. These business leaders accepted the Secretary's invitation, and together with executives assigned by them (Larry Adams from FPL, and Bob Marvin from McDonnell Douglas) began the effort to shape the terms of cooperation. Mr. Hudiburg also assigned a loaned executive, Mr. Alan Siebe, to join the NIST staff during the period from December 1987 to May 1988, to help with implementation.

Early discussions of funding and funding requirements between NIST and Foundation leaders, although entirely cordial, were beset by numerous significant uncertainties. These uncertainties included availability and time commitments of volunteers, application review time, possible need for training of examiners, willingness of companies to donate resources, appropriate fees to charge applicants, costs of winners' sharing, and role(s) of government employees. There were no precedents to draw upon for these discussions. So far as fundraising was concerned, Foundation leaders believed that a few million dollars could be raised from U.S. businesses. This estimate was later increased to about \$10M, provided that President Reagan host a meeting of business executives to express government commitment and to encourage contributions. This meeting with President Reagan was held in Spring, 1988. Vice President Bush, a long-time personal friend of Malcolm Baldrige, also attended this meeting.

In discussions with the Foundation, the law was interpreted to mean that the Award would initially be a business Award, but probably would be opened later to other sectors. The Foundation leaders expressed the view, and continue to stress the point, that the business fundraising effort would address the business Awards only; if other sectors later become eligible, some appropriate alternative funding mechanism should be sought.

Among the purposes of these hearings today is to discuss the staffing requirements and the growth in Program funding. In responding to these purposes, I would like to give the Committee a clear picture of what we do and how current requirements differ from initial requirements.

Award Program Level of Effort: 1988-89 vs 1994-95

Although the Award Program level of effort during the first two years is difficult to determine exactly, owing to the many one-time-only contributions and out-of-hours voluntary efforts within and outside of NIST, I would estimate it at about 7 to 10 staff years (full time equivalents per year) of largely voluntary contributions. This level is now about two and one-half to three times higher. The question arises: why the difference?

To understand the difference between the Baldrige Award Office's level of effort in 1994-1995 versus 1988-1989, it is necessary to understand what these activities are and how and why they have grown.

Five examples illustrate the activities and the changes.

(1) Monitoring the Award Processes

- The integrity of the Award evaluation process is NIST's primary responsibility, as NIST must provide clear assurances to the Secretary and the President that high standards of ethics and competence have been met. An area of great increase in time commitment over the years is the assignment of examiners to applications. The increase in criteria requirements, coupled with the demands for greater reliability and better feedback, have led to a more than doubling of the number of examiners assigned. In addition, the great increases in related awards, business networks, and business partnerships have created many new real and apparent conflict of interest issues that make examiner assignments far more difficult and time consuming.
- After the initial years, it was determined that meeting all these standards and other important Program requirements could be accomplished only if NIST monitored all applicant review processes, including consensus and site visits. The private sector Board of Overseers concurred in this determination. These requirements multiplied NIST's monitoring efforts about tenfold, adding approximately two staff years.

(2) Information Services

- A major role of NIST and the Baldrige Award is dissemination of information. In the first years of the Award, requests for information reflected awareness levels and the number of networks existing at that time. For example, an average of about 38,000 criteria booklets were requested in the first two years, compared with about 180,000 this year. In addition, there were about 5 related awards in 1988-89, versus more than 50 today. Finally, information support to current and past examiners who are sharing the Baldrige message through their volunteer efforts, has become a significant staff commitment. In the early years there were about 100 examiners and no "alumni". Today, there are 270 examiners and about 600 alumni. Information services to this very important community are now about five times the level of the early years. Overall, increased requests for information add approximately five staff years.
- Another major trend in information services that should be noted is the very significant growth in inquiries and types of information requested from non-business organizations. Examples include governmental, health care, education, and non-profit organizations. This trend parallels the experiences of Award winners who also note a growing increase in such inquiries.

(3) Criteria Development and Evolution

- Unlike most awards which are based upon a few general criteria which remain basically the same throughout the life of the award, the Baldrige Award criteria evolve each year. The evolution captures many lessons learned from America's best companies as well as from Baldrige examiners, NIST staff, and other criteria experts. Each year the criteria undergo a comprehensive review. Over the eight reviews since the initial criteria in 1988, the criteria have been modified and expanded in many ways. The criteria and the criteria support materials are now far more comprehensive than earlier, and address a much wider range of performance issues.
- NIST has the principal responsibilities for literature review, criteria development, and management. The level of effort in criteria management varies slightly from year to year but is about one staff year. This is approximately the same as in the early years when the criteria booklet was less comprehensive but the entire effort was new.

(4) Examiner Selection and Preparation

- Examiners are the major resource to the Baldrige Award Program and to the Nation. Their contribution to the Program -- converted to a dollar equivalent -- amounts to twice the current federal budget of the Program, more than \$6M annually. Compared with the first years of the

Award, there are about five times as many examiner applicants. The applicants come from more communities and states, and have more diverse backgrounds. Also, the selection factors are more comprehensive, requiring more rigorous review. Overall, examiner selection involves about seven to ten times the effort of earlier years.

- Examiner preparation is crucial to the success of not only the Baldrige Award but also to the related awards around the U.S. Overall preparation is now more comprehensive, courses have been added for senior examiners, and many more examiners are trained. Overall, examiner training requires about two to three times the effort of early years.
- Overall, examiner selection and preparation combined now consume about two to three more staff years of effort than in 1988-89.

(5) Network Services

- Network services to other organizations, including the States, Award winners, key umbrella organizations, and Manufacturing Extension Partnership Centers, are vital to the success of the national effort. Through these services, other organizations are enabled to better serve their communities. In the first years of the Award, the number and types of networks were much fewer than at present. For example, state, local, and federal award activities are now about ten to fifteen times the level that existed in 1988-89. The network activities are now about five times earlier levels, adding about five staff years.
- Another purpose the Committee set for these hearings is the proposed expansion of Baldrige Award eligibility categories to include education and health care organizations. Below, I have summarized the rationale for such inclusion.

Background

>From the language of the law and from the discussions held to establish the law's intent, it was clear that most people believe that the concepts of performance improvement apply equally well to health care, education, and government as to business, even though these sectors were not initially to be made eligible. Also, early discussions with performance experts indicated that the best performing organizations in these sectors were significantly behind the best performing businesses. Many experts expressed the belief that improving U.S. competitiveness depends significantly upon these non-business sectors, which together account for a major fraction of the U.S. economy. The concerns were and are not only with operating costs in these sectors but also with their customer focus and performance.

Despite the lack of eligibility of health care, education, and government organizations, we decided to appoint some people from these communities to the Board of Examiners and the Board of Overseers, beginning with the first year of the Awards. This was done to help create mechanisms to share information as well as to ensure that the Baldrige Award be broadly representative of the U.S. economy. This involvement proved to be a useful step. Cross-sector sharing of information began to take place, new partnerships were developed, and interest in quality grew in these sectors. Baldrige Award winners, applicants, and participants were particularly active and effective in sharing. Millions of dollars in private resources have been spent on these new efforts. I should add as part of this background that over the years, this Committee has addressed the issue of extending eligibility and received testimony strongly encouraging this action.

Beginning several years ago, there has been increasingly active encouragement to extend eligibility. The Award's Board of Overseers discussed this issue with Secretaries Mosbacher, Franklin, and Brown and received positive responses in all cases. Discussions with the Foundation for the Malcolm Baldrige National Quality Award were less positive, however. The issue was not at all with the appropriateness of extending eligibility, but with how such an effort would be financed. The Foundation leaders believe that using resources raised for the business Awards might undermine these Awards. They believe that leaders in these other sectors should help raise funds for the new categories.

In order to move forward toward a decision, we decided to propose the creation of pilot programs in health care and education for 1995. Although the programs are not yet completed, the early results are very encouraging. We see many positive developments in these sectors similar to those that were occurring in business a few years ago.

Over the years, and more persistently in the last three years, the following rationale has emerged for extending eligibility to health care and education organizations:

- Many business leaders and others believe that improving health care and education is essential to improving national competitiveness. They cite the results orientation of the Baldrige Award -- focussed on better performance and lower cost -- as key to the value of inclusion.
- Many state quality award programs have already extended eligibility to health care and education organizations with clear success.
- The Baldrige Award Pilot Programs in health care and education have shown feasibility to initiate the categories.
- Eligibility of all sectors, with parallel criteria, will foster cooperation across sectors.
- Extending eligibility has been favored by the last three Secretaries of Commerce, the last two Secretaries of Education, and the last two Secretaries of Health and Human Services.
- There is no meaningful basis to exclude health care and education organizations. Exclusion might be seen as arbitrary.

Extending Eligibility: What It Will Take

Any extension of eligibility must happen in an analogous fashion to the business Award categories; that is, through a public-private partnership. Category expansion to education and health care will benefit from economies of scale, since these are "add-on" eligibility categories. However, education and health care also present unique challenges, since these are largely not-for-profit, public benefit sectors. Organizational status of most applicants will make it difficult to charge more than nominal application fees. Also, we cannot expect the same level of pro-bono sharing by winners as exists in the business categories.

Program support will be needed for process monitoring and other Award Office functions in parallel and in cooperation with business Award activities. In addition, funds will be needed to offset application fees and to assist winners, through grants and Award Office support functions, with their sharing of successful strategies. To accomplish all these purposes, a Baldrige Foundation capital base of \$10M for each category is anticipated, volunteer efforts (as we have already seen in the Pilots) will be necessary.

Turning now to another purpose of these hearings -- to review the impacts and achievements of the Baldrige Award Program.

Impacts and Achievements

- The Program operates as a public-private partnership. It is managed by NIST, supported by a private foundation, fees, volunteers, and the American Society for Quality Control (ASQC). The Program is evaluated by a Board of Overseers. Currently, the Baldrige Program involves more than 400 volunteers. Since its inception, it has involved about 1,000 volunteers.
- The Program develops rigorous criteria and training materials used by organizations in all sectors. The criteria drive best practice and serve as a vehicle to spread best practices information to all regions and all sectors of the U.S. economy.
- Award winners and Award participants share information on best practices and performance

results with other U.S. organizations.

- The Program helps to create and support networks throughout the U.S.; the Program disseminates information and maintains people exchanges and collaborations with the networks.
- Award winners (24 winners to date) demonstrate major gains in productivity, cost reduction, product and service quality, market performance, and competitiveness. For example, improvements of 20 to 70% in productivity over 5 years are common.
- Award winners and Baldrige-trained volunteers conduct thousands of information sharing sessions each year at no cost to the Federal Government.
- Well over one million copies of the Award criteria have been distributed. A recent ASQC survey concludes that "the criteria are overwhelmingly used as a source of information on how to achieve business excellence". To date, well over 100,000 people in all sectors have been trained using Baldrige criteria and case studies.
- More than 60 major networks participate in and build upon the Award Program's services. Most of these networks didn't exist in 1987. These networks include about 70% of the states, the United Way of America's Award Program, the Presidents' Award for Quality and Productivity, and the NASA Award (Low Trophy). The Baldrige Program and these networks comprise more than \$100M annually of public and private funding and volunteer services. Volunteer services are the largest part of the overall national award network. There are currently between 4000 and 5000 volunteers participating in the network of awards.

State efforts currently exist in Alabama, Arizona, Arkansas, California, Connecticut, Delaware, Florida, Hawaii, Illinois, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, Nevada, New Mexico, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, the United Way of America and elsewhere. Several other states have planning activities underway.

The Baldrige Award has led to a great increase in cooperation and cross-sector sharing, and more rapid spread of best business practices. As a result of this spread, there is growing interest in these practices in health care, education, and government. The Baldrige Award winners' demonstration of simultaneous and dramatic improvements in quality, productivity, cost, and speed is the major impetus for this interest.

The Award Program conducts an annual fee-supported Award winners' conference, with more than 1000 attendees, in cooperation with ASQC, the Association for Quality and Participation, and the Council on Competitiveness.

The Award Program conducts four fee-supported regional conferences each year with the Conference Board, featuring Award winners from all years. Regional Conferences help information dissemination to medium- and smaller-sized organizations.

Federal Government organizations are beneficiaries of the Baldrige Award criteria and lessons learned. The President's Award for Quality and Productivity, open to all Federal agencies and departments, is based on the Baldrige Award. In addition, Baldrige Award materials are in wide use in Federal organizations, such as the Department of Defense, Veterans Administration, NASA, Postal Service, Department of Energy, and the National Security Agency.

THE BALDRIGE AWARD AND NATIONAL COMPETITIVENESS

One of the purposes of these hearings is to determine the effectiveness of the Baldrige Award in enhancing national competitiveness. The summary given below addresses several aspects of this issue.

The Baldrige Award Program was established in 1987 to enhance national competitiveness. Eight years of operating experience and linkage to numerous networks, thousands of volunteers, hundreds of applicants, and about 40 other nations' quality efforts provides a unique window on national competitiveness.

The Baldrige Award evaluation process has given the U.S. -- and the rest of the world -- an ability to assess and compare organizational performance. There is now much better understanding of the meaning of "best" performance, how best performance compares with typical performance, and how to improve performance.

How U.S. companies have performed in the Baldrige Award evaluation

About 5% of the applicants have performed extremely well, and another 30% or so are making rapid progress. Many of the rest of the applicants are progressing well, but not at a pace that would give them leadership positions soon.

Areas of performance where the leaders excel

The leaders excel in many areas, such productivity, quality, speed, innovation, workforce development, environment, safety, and public responsibility.

Number of companies in the U.S. that could perform at the highest levels of the Baldrige Award evaluation

We believe that there are perhaps a few hundred companies that could today challenge the very high standards of the Baldrige Award. There is a large and widening gap between these companies and most of the remaining several million business entities in the U.S. In other words, the best companies are not only already much better, their rate of improvement is also greater.

How other types of organizations -- health care, education, government, etc., compare with the U.S.' top businesses

It's too early to make any broad judgments, but the Baldrige Award and the award network have involved numerous leaders from these organizations. Overall, the performance of organizations in education, health care, government, etc., lags significantly behind that of the Nation's top businesses. Although awareness of performance improvement practices is growing in these sectors, information transfer is still slow, and too few role models exist in these sectors to support more extensive and better targeted sharing of best practices. To a considerable extent, Baldrige Award winners are serving as role models for these sectors, but this approach is too limiting, and places many inappropriate demands (and costs) on the Award winners.

Implications of the Baldrige Award experiences on the overall national economy

Bearing in mind that the top companies outperform the others in areas such as productivity, quality, speed, workforce development, environment, safety, and public responsibility; the implications to the U.S. economy of closing the performance gap are tremendous. For example, the top companies' productivity growth and investments in workforce development are typically about three to ten times or more the national averages. Clearly, the national improvement potential is very large, particularly if health care, education, government and other organizations are factored into the potential.

Ironically, the top companies seem more aware of the need to improve than do the mediocre performers. In most cases, this awareness was brought about by fierce competition.

Implications of the gap between best performance and typical performance to the overall economy

There are many implications of the gap. One of the clearest implications is "supplier pressure" as the top performers in highly competitive markets demand better quality and lower prices from their hundreds of thousands of suppliers. This could lead to many business failures. Not all such failures harm the overall economy, of course, if other U.S. companies pick up the slack. However, if our most competitive companies are forced to seek overseas suppliers or to move more of their operations overseas, there will be a net U.S. job loss, which usually translates into regional differences. This is why it is important for all regions in the U.S. to understand clearly that national competitiveness means regional competitiveness. The increasingly tough requirements that need to be met must be understood in all regions of the U.S.

Why self-interest and national diffusion of information don't effectively close the gap between best performance and typical performance

To some extent, natural diffusion of information and self-interest do close the gap between best performance and typical performance, but very slowly. Many business leaders spend little time learning about best practices, and cannot afford to take the time to participate in national-level learning. Also, many smaller companies do not have the resources to invest in workforce development, or to support remedial education. In other words, the overall diffusion of best practices information is very slow because it depends significantly upon the performance of our education system. This is why many of the U.S.' top companies are becoming involved in education improvement. Although such involvement by U.S. companies is very important, the resources they have available to commit to education are small compared with the hundreds of billions of dollars already invested in our education system itself.

U.S. competitiveness has improved, but many business leaders are concerned about the future

The U.S.' competitive position is generally better than it was a decade ago. Also, Americans believe by a wide margin that U.S. quality performance is much better than a few years ago. However, the U.S.' top companies are concerned that the U.S. edge might be short lived. They are aware that capital and technology are easily transferable among nations and that lower wage rates and high workforce skill levels in many other nations will soon result in new competitive challenges. There is also concern because many other nations do a better job in education and in the school-to-work transition. Other persistent areas of concern include health care costs, government costs, and government regulation.

The performance gap between the best companies and typical companies that exists in the U.S. also exists in other nations. To a great extent, then, projecting U.S. competitiveness relative to other nations requires projecting relative rates of spread of best practices. This is difficult to do in any exacting way.

It should be noted, however, that most of the U.S.' toughest competitors are much smaller (geographically) with higher relative levels of exports than the U.S. For this reason, natural diffusion of best practices information is likely to occur much more rapidly in these smaller nations.

As indicated above, the ability to assess organizational performance is spreading rapidly throughout the world, owing significantly to the creation of national quality awards and their emphasis on performance measurement and improvement. To date, the U.S. leads the world in rate of spread of best practices due in large part to the creation of numerous networks, such as State, local, and other types. Also, the U.S. is ahead in rate of spread from the business sector to other sectors. These benefits derive heavily from the Baldrige Award criteria that create a consistent framework for sharing best practices and from Baldrige Program educational materials that teach organizations how to use the criteria. Also, Baldrige Award winners and Baldrige-trained volunteers have expended considerable private resources to share their knowledge with organizations in all sectors of the economy.

I pointed out at the outset that I would highlight key observations and conclusions that bear upon

the value of the Award and how it operates.

Observations and Conclusions

Primary Resources

The primary resources in the national effort to improve competitiveness are volunteer time and organizational partnerships, not financial contributions. These primary resources amount to about two-thirds of the national effort. Financial contributions and earnings therefrom amount to less than 10% of the total.

Volunteer efforts and partnerships are effective because the participants gain experiences that benefit themselves and their organizations. As emphasized again and again over the years, the volunteer contributions are a major benefit of the Award Program. In my view, the law either missed this point or greatly underestimated its importance.

I want to make two extremely important points in regard to the volunteer efforts:

(1) To serve effectively, volunteers need to be supported by people who organize and focus their efforts and maintain continuity.

(2) Most of the volunteers contribute great amounts of personal time as well as company time. Because of this extraordinary commitment, the volunteers and their companies deserve and want credit and recognition.

In the Baldrige Award Program, NIST plays the key volunteer support role. Specifically, NIST organizes and manages the volunteer efforts, provides volunteers with information and materials to do their work, and gives them recognition through special ceremonies with the Secretary of Commerce and the President. NIST also helps volunteers in their State and community efforts, most of which operate on very limited resources.

Payment of Fees

Fee paying Award applicants derive benefits, but the main beneficiaries of the Award Program are not applicants, but are organizations of all kinds which do not pay fees. In addition, the main beneficiaries greatly outnumber the applicants (perhaps 1000 or more to 1).

The Baldrige Award Program derives some revenues from applicant participation fees, but such fees do not cover the costs of the overall Program. One could argue that the applicants should pay for the overall Program, if they are presumed to be the sole beneficiaries: This is not the case -- they are not the sole beneficiaries. Nor was this intended by the law. An analysis of this fee and beneficiary situation follows.

Applicants pay three separate fees: for eligibility determination (\$50), application (\$4000 for manufacturing and service or \$1200 for small business), and site visit (amount dependent on complexity of visit). In 1995, an applicant company reaching the site visit stage paid overall fees of more than \$13,000. It is important to note that companies apply for the Award in anticipation of winning and sharing information with other U.S. organizations. This sharing incurs many direct and indirect costs -- well in excess of the three fees described above. These costs are borne entirely by the winning companies.

Implicit in the view that applicants should pay for all or most of the entire Program is that applicants are the main purpose of the Program, that most of the Award Program's activities support the applicants, and that applicants alone capture all or most of the Program's benefits. The law itself makes clear that the Program's main purpose is educational - sharing information about successful quality strategies. This means that the law requires that Award applicants and Award winners not be sole beneficiaries. In other words, the Award could not be given to a company

unless it is willing to share information with other U.S. organizations. Indeed, the public nature of the winners' sharing means that even business competitors of Award winners have access to information about the winners' successful strategies. In addition, non-winning applicants contribute significantly to national sharing, but do not even receive recognition via an Award.

The Baldrige Award Program works to ensure that information about the winners' successful strategies reaches the largest possible audience -- many tens of thousands of organizations of all types each year. These organizations are the main beneficiaries, and helping them improve their performance is the main purpose of the Award Program. This information sharing involves efforts by thousands of volunteers in the national "Baldrige network", and coordination and educational materials provided by the Baldrige Award Program staff at NIST.

Expecting the applicants to pay for the whole Program misses both the purpose of the Program and its operational strategy: non-applicant beneficiaries outnumber applicants more than 1000 to 1. Moreover, this ratio continues to increase.

Donations

Donations have been an important part of the Baldrige Award Program, but donations do not tend to operate as a "free market" - allocating donations and benefits in a reasonable way. The current donation system, taking into account the fact that the donors are also the companies that are principal contributors of volunteers, is highly distorted. Further distortion would mean that America's companies would be asked to assume the role of government, including paying for government employees. Moreover, a principal role for these employees as civil servants is to make certain that the main benefits address key needs, serving mainly those who have not made donations.

The Foundation for the Malcolm Baldrige National Quality Award has raised over \$10M and makes an annual contribution of more than \$600K. The Foundation is capitalized through donations made by about 150 companies. More importantly, these and other companies and organizations donate the services of executives and employees to the Award Program. The estimated value of these services exceeds \$6M per year. This does not include the donated services of the 24 Award winners, which are substantial -- reflected in thousands of sharing activities each year.

A funding system based upon donation works best (in principle and in practice) when the donors and beneficiaries overlap substantially and levels of donation are reasonably proportional to benefits. In the Baldrige Award, the beneficiaries greatly outnumber the donors, and the donor pool is narrow (larger companies) compared with the main beneficiary pool (small businesses, government, health care, education, etc.). Based upon the estimated 10 million organizational units in the U.S. of the type that participate in and/or benefit from the Baldrige Award process, the average "fair share" contribution needed to displace the Federal payment of \$3M would amount to about 30 cents per year per donor (not amenable to an easy or cost-efficient collection process).

A proposal to fully fund the Baldrige Award Program via donations would mean that a few donors should pay all costs, so that a large number of beneficiaries -- who are the main purpose of the Program -- do not have to pay at all. NIST funding for a portion of the Program is based upon the principle that government funding actually comes closest to balancing costs and benefits, at minimum collection cost and requiring no new collection mechanisms or regulations.

Creating a More Extensive Fee System

Fees have been an important part of the Baldrige Award Program when there has been a clear "transaction point" (benefits transfers) where value versus fee is easily determined. For example, fees are charged for applications and conferences. However, most of the key transaction points related to the Baldrige Award do not involve NIST, and to change this situation would be costly and intrusive.

A fee system works best (in principle and in practice) when the fees are commensurate with benefits. A fair, efficient, and non-intrusive fee system operates as follows:

(1) those that pay, benefit (2) those that benefit, pay (3) benefits and payments are reasonably proportionate and clearly linked (4) fees do not prevent or distort the delivery of principal benefits (5) the fee system does not impose significant new costs or create undesirable collection mechanisms.

If the service involves the government, and the government itself is to receive payment, the government itself must be a party to the transaction. Otherwise the government would need to establish some rules and regulations regarding transactions when it is not an involved party, or inject itself as a party in the transactions so that it can receive payment. The former represents an onerous burden, imposing new costs to the government and to the private sector. The latter is intrusive, adds no value, discourages volunteer activities and is even more costly.

A rough estimate of the number of "transactions" per year involving activities of the Baldrige Award and related awards is in the millions -- perhaps many millions. Because of the Award Program's strategy of decentralization and local leadership, only a very small fraction of the transactions now directly involve NIST.

The above analysis shows that a more extensive fee system built around beneficial transactions derived from the Baldrige Award would have several undesirable characteristics:

It would be regulatory or intrusive.

Collection costs would actually exceed amounts to be collected. (The amounts to be collected would need to be one dollar or less per transaction, if overall collections are to pay the costs now borne by NIST).

NIST's costs would increase and its activities would be driven heavily by fee considerations rather than primarily by benefits. This would be especially troublesome in interactions with State and local programs that operate largely through volunteers, struggle with resources, and could not afford to pay NIST fees for sharing of criteria, experiences, and educational materials. Indeed, charging for the intellectual costs associated with producing public domain documents is questionable.

Sharing by Award Winners

Sharing by Award winners is the major value of the Award. Nevertheless, the law does not indicate or provide mechanisms for this sharing to occur. As a result, sharing occurs via numerous avenues, many of which create serious strains on Award winners and on the Award Program Office.

The law provides for up to six winners per year. Within the U.S., there are perhaps 10 million organizational entities of all types and sizes and in all sectors. In many organizations, improvement efforts are fragmented, creating even more groups that might seek information from the winning companies. How is sharing to occur?

Although the level of sharing is extremely high -- much higher than anticipated in 1987 -- many organizations, particularly smaller ones, are not reached. Nevertheless, pressures on the resources of Award winners have led some potential Award applicants to conclude that the "cost of winning" is prohibitive.

The Baldrige Award Program conducts conferences featuring the Award winners, but such conferences meet only a fraction of the need. A major part of NIST's strategy over the years has been to foster partnerships and networks throughout the U.S., so that the sharing could occur more

quickly and efficiently. This requires dedicated resources for NIST to carry out such collaborative "infrastructure" building. The Council on Competitiveness' proposal to have the Baldrige Award Program become the Baldrige National Quality Center represents a practical step in this direction.

The NIST Role: An Analogy with Standards Development

Operating the Baldrige Award is a logical extension of NIST's work in measurements, standards, and services to industry.

Although the Baldrige Award criteria are not a "standard" in the usual sense of the word, the criteria are widely used as a standard, and fulfill many of the purposes for which standards are developed. In addition, the criteria are far more general than most standards, and hence find use in a wider range of applications and communities. Their use in multiple communities enables numerous benefits not achieved by "real" standards. For example, the Baldrige criteria foster communications and cooperation across sectors and within sectors.

The concept of families of criteria emerging from the Education and Health Care Pilot Programs as well as from the State award programs, the United Way of America Program and others, offers a powerful means to better align institutions and resources (trillions of dollars) behind common purposes, while maintaining the identity and character of the different institutions. The families of criteria also enlarge the concept of best practices to include numerous relationship issues, such as customer - supplier and business - education partnerships.

The Baldrige Award and the State and local awards have spawned numerous partnerships, most notably State-Federal and State-State.

The larger purposes of standards in society are to reduce transaction costs and increase benefits to buyers, sellers, and those affected by the transactions. Throughout the world, governmental organizations and private sector bodies have been involved in standards development. Usually, standards cover a narrow scope, and are developed by technical experts in specific areas. Consensus is important, as standards can be defined in ways that distort markets or favor one technology or product over others. Consensus may also be hard to reach, owing to competing interests. Governments play a vital role in convening the parties and in "brokering" the consensus processes.

The Baldrige Award Program has played this convening/brokering role for eight years through creation and eight revisions of a highly complex "standard". Much less complex standards might have undergone only one or two revisions in a comparable time period. Thus it would be hard to argue that government leadership has slowed or distorted the process. The fact that private sector communities, including scores of communities not previously associated with NIST, accepted NIST's role, reflects the long tradition at NIST to effectively convene and broker diverse parties. In addition, much of NIST's technical programs and services are broadly supportive of quality improvement. The issues associated with standards and their technical support are becoming far more complex and crucial as world trade grows and competition intensifies. Fragmentation of U.S. standards efforts could work to its disadvantage.

The connection between the Baldrige Award criteria and standards has become an important one, as about 40 other nations have used the Baldrige criteria as a template for their competitiveness improvement efforts. The strong performance of U.S. companies in these other-nation award programs illustrates the value of world leadership for the U.S. in this area. Japan, heretofore the acknowledged leader in quality, is currently conducting a Baldrige experiment. A major part of their rationale relates to the success of the Baldrige Award in involving all sectors of the economy, and the Award's promoting sharing of best practices.

Turning now to the law which created the Baldrige Award, I have a few comments regarding our experiences trying to work toward the law's very significant aims.

First, a general comment. The basic thrust of the law is sound. The language spells out clear purposes and directions, but does not overly prescribe methods or criteria. This offers considerable latitude in interpretation and in implementation.

We have experienced some major difficulties with the law, however. One such difficulty is the limit of 2 on the number of awards that may be made in each eligibility category. There are two problems with the limit, both important to the success of the national effort to improve performance:

(1) The limit inhibits sharing of best practices information among some of the U.S.' most competitive companies. We would like to see companies which vie for the Award help one another because we believe it is in the national interest to have many world leading companies in the U.S.

(2) The limit discourages some excellent companies from participating.

The issue of this limit has been raised often during the past five years. We have always emphasized that removal of the limit would not lower the standards of the Award. In fact, the standards have become tougher over the years and we believe they must become even tougher. The Baldrige Award Judges again echoed this concern, during their meeting last week, and asked that I emphasize at this hearing their support for removing the limit of two Awards per eligibility category.

Another area of difficulty with the law, relates to the issue of the winners' sharing. The law on one hand limits the number of winners to a few per year. On the other hand, the law requires that winners share with other U.S. organizations. To make an impact, such sharing must involve hundreds of thousands or even millions of other organizations. This is beyond the resources of even America's largest companies. While the Award Program, working with others, including the Award winners, has made much progress in creating pathways for sharing, we have yet a long way to go. The demands on the Award winners, particularly smaller ones, are too great. Most have continued to share well beyond the one year of sharing we ask of them. Were it not for this continued sharing, the national effort would not have advanced nearly as well as it has. The Award Program should build networks and create materials to accelerate the pace of sharing. Such approaches should be carried out in collaboration with others, which has been the mode of operation of the Program from its inception.

The paragraph of the law dealing with funding assumes that donations and fees -- cash flow -- are the "life blood" of the Award and what it is expected to accomplish. Our experience shows that this assumption is seriously misdirected. The life blood of the Award is the energy it has unleashed in thousands of volunteers, in the Award winning companies, and others. Their efforts over the years translate into many hundreds of millions of dollars of benefits to the U.S. More importantly, their efforts translate into a renewed belief that U.S. organizations can be world leaders. We are learning about what this leadership is, how it works, what it produces, and how we can measure it. We are learning about how to align institutions, including the federal government, to address what is now a major challenge - to remain competitive in the face of intensifying competition. Other nations have noted what we have done and are moving to emulate us. We need to be concerned that they might do a much better job than we have. The federal contribution -- only a few percent of the total national effort and well below the government's proportion of GNP -- is critical to the success of this national effort.

There is a great deal of discussion these days about the benefits and costs of government programs. Such self-examinations have been part of the business scene for some time. Driven by competition, our best business leaders are learning to assess the "value added" and modes of operation of all business activities. The results in many cases have been dramatic improvements. But these gains we see in the Baldrige Award winners are still very rare in business, and rarer still in our other institutions. The Baldrige Award is about understanding and facilitating the sharing of the practices that enable the major gains the Award winners have demonstrated.

That we have made progress with very small federal expenditures speaks to the vast resources and energy contributed by our partners in the national effort -- the Award winners, the Award applicants, the Examiners, Overseers, State programs, ASQC -- to name a few. We wish to thank them all for their part in this experiment in our national life -- to build a partnership to improve our institutions.

In closing, I wish also to thank the Committee for giving me this opportunity to describe the Baldrige Award Program and some of its accomplishments. As a small part of a small agency in a relatively small government department, this level of attention is most gratifying.

Statement of

Raymond G. Kammer

Director

National Institute of Standards and Technology U.S. Department of Commerce

before the

Senate Committee on Commerce, Science, and Transportation Subcommittee on Science, Technology, and Space

on Computer Security in the Federal Government

February 10, 1998

Thank you Mr. Chairman and members of the Committee for inviting me here today to testify on the critical issue of computer security. I am Ray Kammer, Director of the National Institute of Standards and Technology (NIST), a component of the Technology Administration at the Department of Commerce. NIST's mission is to promote U.S. economic growth by working with industry to develop and apply technology, measurements and standards. In the computer and communications area, our Information Technology (IT) Laboratory provides technical leadership for the nation's measurement and standards infrastructure for IT. One component of our IT Laboratory focuses exclusively on security issues. As requested in your invitation, it is the IT security work of NIST's Computer Security Division that I would like to focus primarily upon today.

Let me commend the Committee for focusing on the issue of computer security. As you recognized in calling today's hearing, security is a critical component necessary to meet the needs of both industry and government in achieving economic and social benefits from applications of IT, including in the important area of Electronic Commerce. Your hearing is also particularly timely given the recent report issued by the President's Commission on Critical Infrastructure Protection highlighting security issues. I will not dwell on threats to computer systems, other than to note that they are wide-ranging and show no sign of diminishing. They include such threats and risks as: sabotage, loss of infrastructure support, malicious hacking, industrial and state-sponsored espionage, human error, fraud, and viruses as well as other types of malicious code.

NIST's activities in the area of computer security address requirements of both the IT industry and federal agencies. Our industry customers include the vendors of general IT products as well as security-specific products. NIST's responsibilities are specified in the Computer Security Act of 1987 (and were reinforced under the Clinger-Cohen Act, more formally known as the IT Management Reform Act of 1996). In addition, OMB's Circular A-130 (Appendix III) expands on these and gives NIST a number of specific responsibilities in support of agency computer security efforts. Last, the Computer Systems Security and Privacy Advisory Board (CSSPAB), provides us with valuable input on emerging security issues and other matters.

Another recent development is the Federal Government's concern over the security and robustness of the nation's critical infrastructures, as these are increasingly dependent on information technology and computer networks such as the Internet. NIST computer security programs and expertise will help address problems involving these infrastructures.

NIST has developed a strategy that recognizes the essentially common security needs of the majority of government agencies and the private sector. In particular, we believe that the best way to provide security for Federal Government systems is to make maximum use of commercial products, services, standards and technology. NIST works with the private sector to foster the availability of high quality security products that may be used by both private sector and government organizations with confidence

- thus achieving higher levels of security and interoperability for both. The NIST IT security program focuses on those technologies and needed infrastructures that will achieve these goals. Briefly, the key focus areas in the NIST IT security program are the following:

1. Security Criteria and Testing,
2. Internet and Network Security,
3. Cryptographic Technology and Applications,
4. Public Key Infrastructure, and
5. Security Management

These areas address some of the most critical issues facing organizations today as they expand their uses of computers and networks. By focusing on these key areas, NIST is able to leverage its unique expertise in standards and measurements to help both government and the private sector. Let me briefly discuss each.

The goal of our first focus area, **Security Criteria and Testing**, is to promote the development of objective criteria for testing and assessing the functionality and assurance of security technology and products. This is needed because, when it comes to security, organizations (including government) are looking for independent assurances that the security features of products indeed perform "as advertised." Many of our activities in this area are being accomplished under our recently-announced "National Information Assurance Partnership" (NIAP). NIAP is a NIST/NSA-sponsored forum through which industry and government organizations can collaborate to develop security metrics, tests, test methods, tools, reference implementations, and protection profiles. These can then be used by independent, private sector testing laboratories to conduct product tests and certifications. It is important to note here that NIST does not intend to perform tests or product certification - only to help provide the necessary elements to support usable and credible formal test processes. In this way, government (and industry, to the extent it needs tested products) will be able to procure and deploy security technologies and products that have been independently tested. NIAP will also serve as the mechanism for mutual international recognition of evaluation tests conducted under the "Common Criteria" program, an internationally agreed upon means to specify security functionality and assurance so that tests for conformance can be conducted.

Because NIAP promotes the development of security product testing through independent, private sector laboratories, we hope that this will lead to the greater commercial availability of secure products for use in protecting government (and, again, to the extent needed, industry) information systems. NIAP also is laying out a course for transition of existing government-conducted security product testing activities to commercial testing laboratories, thus supporting the development of an American IT testing industry which is commercially viable and sustainable.

Much of the work of NIAP is supported by the "Common Criteria" (CC), on which NIST has been working for some time. The goal of this effort is to provide a detailed technical specification which can be used to describe, with technical precision, the security functions of an application, security product, or system (which subsequently may undergo security testing). The CC also provides a means to specify a corresponding "assurance level" of a product, meaning, in effect, the degree of confidence one may have that a given product's security features operate as specified. This will allow for a range of testing, from a fairly quick review, to an in-depth, technical product review. The degree of testing appropriate will, in part, be determined by the threat and risk environment (including the sensitivity of information) in which a given product is intended to operate.

The goal of our activities in the area of **Internet and Network Security** is to provide interoperable security capabilities across networks and user "domains." What exactly does this mean? Many of the networks in existence today, notably the Internet, were not designed with security functionality in mind. A challenge that faces us today is how to migrate to new technology that provides for a higher level of security. One key area that NIST has focused on to accomplish this is to work with the Internet Engineering Task Force (IETF) to develop the technical security protocols for use in the new version of the supporting network security protocols (known as "IPSec"). We have developed a security reference implementation, which will be widely distributed and can be used to test for interoperability by builders

of IPsec products. IPsec provides for security services for both the currently-deployed Internet Protocol (IP) version 4 and the emerging IP version 6.

Another important activity that NIST has undertaken, particularly to address the needs of our federal customers, is the Federal Computer Incident Response Capability (FedCIRC). This is an initiative originated by NIST and made operational in October 1996, which helps address the need in the Federal Government for network incident response capabilities. FedCIRC provides, under NIST auspices and in collaboration with DOE's Computer Incident and Advisory Capability and Carnegie-Mellon University's Computer Emergency Response Center (CERT), a variety of subscription funded services such as site evaluation, incident handling services, access to incident and vulnerability advisories, and training opportunities.

Thanks to startup funding from the Government Information Technology Services (GITS) initiatives, we are able to provide 7-day-a-week, 24-hour-a-day service. To date, we have handled more than 75 incidents from the civilian side of government since we became operational. Additionally, we have fielded hundreds of other requests for information and assistance. Through its workshops and seminars, FedCIRC has trained over 1000 individuals on various aspects of computer security. In conjunction with other federal agencies, we are currently looking at ways to continue this important activity beyond that provided for by the initial one-time GITS start-up funding.

Our next focus area is **Cryptographic Technology and Applications**. The goal of our work in cryptography is to ensure the availability of high-quality cryptographic technology standards, tests, and application program interfaces to that technology. NIST's work in cryptography focuses not only on core algorithm-based standards and associated conformance tests, but higher level standards and tests for the "modules" in which algorithms (and other cryptographic-related functions are implemented). Included at the algorithm level are such activities as our development of the Advanced Encryption Standard and our work with the American National Standards Institute (ANSI) on digital signature standards for RSA and Elliptic Curve techniques. At the module level, our work is focused in our Cryptographic Module Validation Program. I will briefly explain each of these in more detail.

Advanced Encryption Standard (AES). In January of last year, NIST announced that it would begin the process of working with the private sector on an Advanced Encryption Standard (AES). As you may know, the Data Encryption Standard (DES) has been the operative private sector standard, as well as formal government standard, for assuring the confidentiality of information for almost two decades. DES will continue to provide adequate levels of security for many applications for years to come. However, in an effort to look ahead, NIST has begun the work with the private sector on AES in anticipation that demand for the next generation of encryption standards will require a concerted, multi-year effort to evaluate, develop and build consensus towards acceptable long-term standards. We are pleased by the response of the private sector to this initiative, and we look forward to receiving candidate algorithms nominations by the mid-June deadline. Thereafter, we plan a series of public workshops and comment periods before selecting an algorithm for the AES.

Expanded Digital Signature Standard NIST also has requested public comments on additional algorithms that the federal government may endorse to authenticate electronic information and transactions and assure high levels of integrity. This initiative will expand the number of techniques that the Federal government should be using in the area of "digital signatures" and should bring forth the best and most cost-effective technologies that the private sector has to offer. I want to note that we have specifically asked for comment on elliptic curve technology and on RSA's digital signature technology. We have been working with accredited voluntary standards committees of ANSI to finalize standards for both technologies, which we intend to recommend for federal use with appropriate implementing guidance.

Key Agreement / Exchange. In a third area, we have also sought public comments on potential technologies that assure very secure "key agreement or exchange" protocols as part of public cryptographic systems. There is no existing federal standard in this area, and we have specifically asked for comments on the following technologies: RSA, elliptic curve, and Diffie-Hellman. We are also working with the ANSI voluntary standards committees on these standards, which we plan to adopt for

federal use as appropriate.

Key Recovery. NIST is also pursuing technical work in the area of key recovery for government applications, to ensure the availability of encryption keys, for both user and public safety requirements. We have provided technical support for the key recovery pilot tests sponsored by CITS. We also support the Department of Commerce's advisory committee to gain industry's advice as to how the government should accomplish key recovery for itself.

Cryptographic Module Validation Program. While sound algorithms are critical to providing for strong cryptographic-based services, they are insufficient in and of themselves. It is also necessary that the module in which cryptography is implemented (either hardware or software) be secure. For example, one issue that must be addressed is how are cryptographic keys protected within the module. Therefore, NIST, in conjunction with industry partners, developed the *Security Requirements for Cryptographic Modules* standard which specifies four security levels for cryptomodules. Under its National Voluntary Laboratory Accreditation Program, NIST has accredited Cryptographic Modules Testing (CMT) laboratories to perform validation testing of cryptographic modules. Netscape told us that, as a result of successful testing under this program, the Department of Defense recently purchased 2 million copies of their web browser.

Our projects in the area of **Public Key Infrastructure (PKI)** are aimed at ensuring the interoperability and security of the crucial components of the public key infrastructure needed to support electronic commerce and government activities. Public key technology holds great promise for improving the security of systems and serving as a key enabling technology for Electronic Commerce. However, in order to enable truly global capabilities, and to avoid independent islands of users who cannot talk to each other, interoperability issues must be addressed. Additionally, in order for users to have trust in the system, the security issues in the various components of the PKI must be also be addressed.

NIST has recently completed initial work in the area of PKI by developing, with the assistance of ten cooperative research and development agreement partners in industry, a Minimum Interoperability Specification for Public Key Infrastructure Components (MISPC). NIST is continuing this work with development of reference implementations of public key Certificate Authorities and related technical development.

Our final security focus area is that of **Security Management** to provide guidance in the selection, implementation and use of security technology in their systems and networks. We recognize that technology does not provide strong security in isolation there are always complicating human factors. Technology appropriate to the risk and threat environment must be selected. It must be correctly installed and managed by knowledgeable, trained personnel. Organizations must have appropriate policies and security in place throughout a system's functional life-cycle. In order to address such critical managerial and operational controls, NIST develops and issues guidance to agencies.

Our basic overall approach to these security management issues was laid out a few years ago in our Computer Security Handbook and has been supplemented via numerous other publications. For example, during the last year, ITL has issued bulletins on security issues for telecommuting, audit trails, security considerations in computer support and operations, PKI technology, and Internet electronic mail. Thanks to our collaborators in the Federal Information Systems Security Educators' Association and the Federal Computer Security Program Managers' Forum, we are currently coordinating two new draft guidelines on training and planning, respectively.

The Federal Computer Security Program Managers' Forum, which we sponsor, provides an informal venue for federal officials to exchange real-world computer security issues and solutions. The Forum also provides a means for NIST to share its advice with agencies, and to draw upon the computer security expertise at other federal agencies in developing guidance documents.

NIST has also undertaken a long list of activities with federal agencies designed to improve agency security management, education and awareness, and use of security technology. NIST staff would be happy to discuss this with you further.

Mr. Chairman, I want to thank you again for the opportunity to speak to your committee on NIST's computer security activities. We at NIST look forward to working with your committee and others in the Congress on this important issue.

**Statement
of
Robert Mallett
Deputy Secretary of the Department of Commerce
before the
Senate Committee on Commerce, Science, and Transportation
on the
Year 2000 Computer Problem
Tuesday, April 28, 1998**

Introduction

I am Robert Mallett, Deputy Secretary of the Department of Commerce. I am pleased to be here with you today to discuss the year 2000 computer problem and activities the Department of Commerce is taking in response to this problem.

The Department's primary mission is to ensure economic opportunity and a high standard of living for all Americans through economic growth and job creation, promotion of trade, and advances in technology. The Department implements programs that support research and development and promote the application of innovative technologies to commercialization of business processes; protect life and physical property; manage natural resources and tell us much about the natural environment; ensure protection of intellectual property; expand opportunities in the international marketplace through export licensing; provide management and technical assistance to minority business and economically distressed areas; and collect and disseminate economic and demographic data and environmental information used by private and public sector policymakers to measure our national economic well-being. Given the Department's mission, the year 2000 problem is of particular concern.

Some 60 senior corporate executives from companies including Texas Instruments, Unilever, Ford, Bombardier, and Lloyds TSB Banking recently warned President Clinton and the Prime Ministers of Britain and Canada that government failure to solve year 2000 problems could produce "delays in welfare payments, the triggering of financial chaos by a breakdown in revenue collection and debt management, and malfunctions in the air traffic control and defense systems." We can already see the initial effect of the year 2000 crisis on our economy.

While Commerce itself does not have regulatory authority over private industry business sectors, we do recognize that the Department can play a supportive role in encouraging businesses to address the year 2000 problem in an aggressive fashion. Secretary Daley has been an active leader in promoting year 2000 awareness in the business community, domestically and, more recently, internationally. He has done so in recent visits to South America and will in upcoming overseas missions to Africa. While many businesses have taken positive steps to ensure continuity of operations beyond the year 2000, there is a level of inconsistency throughout the various business sectors. There is also a great deal of disagreement between the costs estimated by U.S. businesses, and those by research groups studying the problem. One thing we do know is that the year 2000 problem poses a significant risk to industry's ability to conduct business beyond December 31, 1999. Not only could the costs of correcting this problem eat away at company profits, the inability to conduct business and potential liability costs could force some companies to go under. Commerce will do everything it can to minimize the consequences of this problem.

Department of Commerce Year 2000 Management Program

The goal of Commerce's internal year 2000 program is to manage successfully and efficiently the conversion of our information systems to process data accurately into the next century. This will allow us to continue to meet our business requirements. Like other Government agencies, we are using a five-phase approach to the year 2000 problem. The phases and corresponding target dates for completion are as follows: Awareness (August 1996), Assessment (March 1997), Renovation (September 1998), Validation (January 1999), and Implementation (March 1999).

Our management program divides responsibilities between the Department and its operating units. At the Department level, responsibilities include overall Department coordination and risk management, development of the Department's Year 2000 Program Management Plan, Departmental guidance and policy, coordination of the conversion of cross-cutting administrative systems, program oversight, and participation on the CIO Council Subcommittee on the Year 2000.

Operating units have responsibility to conduct assessments of information systems under their purview, develop and implement an action plan for becoming year 2000 compliant, and prepare inventories of information systems and data exchanges. The operating units must also identify specific year 2000 costs, prepare contingency plans for systems at risk, coordinate external and internal data exchanges, and coordinate with the Department to ensure the compliance of administrative systems.

The Department of Commerce has undertaken a number of communications and leadership initiatives to address the year 2000 issue. At each Commerce Chief Information Officer (CIO) Council meeting, we discuss the year 2000 problem. The Department has formed a Year 2000 Working Group, which is chaired by the Department's day-to-day year 2000 program manager and consists of representatives from each operating unit. The group meets monthly to exchange ideas and report on progress regarding year 2000 conversions. The larger operating units have implemented similar year 2000 risk management groups. Commerce has prepared a comprehensive Year 2000 Program Management Plan, which includes our overall strategy as well as specific tips for each phase of the conversion process.

In the area of awareness, Commerce started its efforts in December of 1995 with a briefing from Social Security Administration technical staff to senior Departmental technology managers. Recent activities include a Commerce CIO Council meeting in January 1998 devoted exclusively to the year 2000 issue. Operating unit CIO's provided status reports on their year 2000 efforts. Year 2000 will be a priority topic at the Department's Information Technology/Acquisition Management Conference in May 1998, as it was at the June 1997 conference.

At the assessment level, in August 1996, the Department requested that operating units inventory their systems, assess the impact of year 2000 computer processing problems, develop a management action plan, and identify the necessary resources to resolve the problem. In June 1997, we requested that the operating units update their inventories to prioritize mission-critical systems, identify internal and external interfaces, and define renovation- replacement-retirement status. And like other Cabinet agencies, Commerce files quarterly status reports with the Office of Management and Budget (OMB), including detail by operating unit.

As of the February status report to OMB, Commerce showed that 63% of its 470 mission-critical systems were year 2000 compliant. Of the 110 systems to be renovated, 42% of the renovations were completed. Estimated year 2000 conversion costs were \$83.4 million. Based on the February data, OMB classified the Department of Commerce as a tier 2 agency, one that is making progress but for which there are still concerns.

The Department of Commerce has performed its own triage assessment of operating unit progress using a red-yellow-green measurement system. Based on this assessment and following concerns expressed by OMB, the Department held meetings with key officials in the Census Bureau, Patent and Trademark Office (PTO), National Oceanic and Atmospheric Administration (NOAA), and International Trade Administration (ITA) to discuss year 2000 progress and identify risks and concerns. In the area of contingency planning, we are currently renovating non-compliant systems where replacement systems delivery is at risk. Using the General Accounting Office exposure draft on Business Continuity and Contingency Planning as guidance, we will develop a high-level business continuity strategy, assess the potential impact of mission-critical system failures on Commerce's core business processes, and identify and document contingency plans and implementation modes.

For electronic data exchange, we are encouraging operating units to convert systems and data to a four-digit year field format whenever appropriate and providing multiple formats where practical to allow maximum access by the public to Commerce data. Of Commerce's 265 electronic data exchanges, 239 are with other Federal agencies. Only the Census Bureau conducts electronic data exchanges with

States.

Current program efforts include identification of the Department's top priority mission-critical systems and renovation efforts, development of a Commerce year 2000 Internet Web page to complement a year 2000 page already in place from NIST, establishment of a contract vehicle for conducting independent verification and validation of year 2000 conversions and replacement systems, and assessment of non-information technology products (telecommunications, elevators, security systems, heating and ventilation systems, fleet, and aircraft). Possible future program activities include asking owners of the most critical systems to come before the Commerce Information Technology Review Board to explain their year 2000 programs, progress, and concerns and holding a year 2000 stand-down day, inviting outside speakers and year 2000 vendors to present their services.

In short, the Commerce Department has an active and multi-faceted year 2000 management program. We are making steady progress, though we recognize that much work remains.

Even with the positive reports the Secretary and I have received about the progress Commerce bureaus are making, we are carefully scrutinizing where we stand. Our operating philosophy derives from an old President Reagan quip about the Soviet Union's compliance with arms control rules: Trust but verify.

Commerce's Outreach to the Business Community

John Koskinen, assistant to the President and chair of the President's Council on the Year 2000 Conversion, notes that the Federal government has a responsibility to exercise leadership to increase awareness of the year 2000 problem and to offer appropriate assistance and support. The Department of Commerce heartily agrees. Next I would like to describe outreach, research, and guidance activities we have already undertaken and those we plan to pursue in the future.

National Institute of Standards and Technology

The Department of Commerce, through the National Institute of Standards and Technology (NIST), has been active in various arenas of the year 2000 issue, through standards organizations, direct contact with users of these standards, and the development of testing techniques and strategies. NIST is also taking advantage of its ties to smaller manufacturers through its Manufacturing Extension Partnership.

Commerce recognizes that there is no across-the-board solution to the year 2000 problem and no need for additional date format standards. National and international date format standards already exist. A single date processing standard would not be meaningful due to the numerous individual agency requirements within specific applications and systems. Date processing routines are already provided in many programming languages and software development environments. However, NIST has been working on an array of other helpful activities, including:

Small Business and Manufacturing Outreach

- NIST's Manufacturing Extension Partnership (MEP) helps small and medium- sized manufacturers -- a significant element of our economy -- with year 2000 problems. For example, the MEP center in Michigan has been conducting year 2000 overview seminars for Michigan's smaller manufacturing firms and is planning to conduct user support groups for mutual and NIST-assisted help with year 2000 project planning and management. Adopting this approach, the MEP centers in all 50 states and Puerto Rico are positioning themselves to deliver year 2000 awareness seminars, client assessments, and remediation planning. In addition, NIST personnel participate in presentations and workshops -- primarily as invited speakers -- to raise awareness and present practical solutions to organizations of small businesses and manufacturers throughout the United States.
- As we approach the year 2000, the Department of Commerce intends to continue its leadership in helping our economy avoid any problems associated with year 2000 computer errors. In the coming year, NIST will hold a series of information-sharing workshops for a variety of audiences

in different locations. These workshops are now in their initial planning stages. We have targeted one for State and local governments this June. We are planning regional conferences around the country beginning in September focused on helping American businesses. We will coordinate this session with the Small Business Administration, which has an outreach initiative to the small business community, and our Manufacturing Extension Partnership, which has an outreach initiative for the manufacturing community. Further, Secretary Daley is planning an international workshop in October to assist other national governments. Despite its problems, the United States is far ahead of most other countries in confronting the problems. Canada and the United Kingdom have taken a number of steps, the rest of the developed world fewer steps, and the developing world almost none at all. Thailand, for instance, has yet to conduct a potential damage assessment, let alone budget funds for repair. In February, Mr. Chairman, your colleagues Senator Robert Bennett (R. - Utah) and Senator Christopher Dodd (D. - Conn) warned Treasury Secretary Robert Rubin that lack of attention to the year 2000 snare "will cause international financial disruptions larger than the current Asian crisis." Secretary Daley, Ambassador David Aaron, our Under Secretary for International Trade, and I are committed to raise this concern in all our international dialogues with our overseas counterparts and with the foreign business community.

- NIST International Symposium on the Year 2000 -- "The Millennium Rollover"

To help raise awareness of the problem internationally, NIST held an International Symposium on the Year 2000, June 9-10, 1997, at its Gaithersburg campus. With over 35 speakers from national and international organizations, a number of year 2000 issues were discussed. Topics included the management and technical issues of year 2000 conversion, testing for compliance to date/time processing requirements, the market development of conversion tools and vendor services, resource tracking and monitoring, case studies by corporations and national governments including those of Australia, Sweden, and the United Kingdom, and legal aspects of product/vendor liability. Special sessions on international aviation year 2000 issues and test methods for year 2000 were also included, as well as an exhibition that showcased over 20 vendors and their products to demonstrate different approaches available right now.

- Development of a specification for defining the types of tests needed for date/time testing in software.

This specification, "Draft Test Assertions for Date and Time Functions," written by NIST, defines assertions for use in testing date and time functions. The test assertions are based on common needs found in numerous sources and application requirements including various programming language, database, network, and operating system specifications and standards.

- Participation in the IEEE Study Group on Year 2000 Test Methods.

NIST hosted the second meeting of the Institute of Electrical and Electronics Engineers (IEEE) Study Group on Year 2000 Test Methods at the International Symposium on the Year 2000. The goal of the Study Group is to produce a set of "recommended practices" sanctioned by the IEEE and industry for developing tests of software and hardware to assure that the software and hardware are not affected by date/time problems. NIST's "Draft Test Assertions for Date and Time Functions" is one of the base documents for consideration in the development of the recommended practices document. Meetings of the Working Group are continuing and a draft document for ballot is being readied for mid-1998.

- FIPS 4-1 and Change Notice.

A change notice to Federal Information Processing Standard (FIPS) 4-1 on date formats was issued on March 25, 1996, recommending use of the four-digit year format and discouraging use of the 2-digit year format. The original FIPS was issued as FIPS 4 in 1968, based on an American National Standards Institute (ANSI) standard.

- Year 2000 Bulletin

NIST published a Bulletin on the Year 2000 Problem in March 1996 to raise awareness of the issues and to propose methods for managing the conversion of systems to year 2000 and beyond. A proposal for a second Bulletin on Year 2000 Solutions is in process.

- Interagency Committee on the Year 2000.

NIST is a member of the U.S. Government Chief Information Officer Council's (CIO Council) Committee on the Year 2000, which assists Federal agency efforts in converting systems to year 2000 compliant systems by promulgating information gathered through the Committee's efforts in researching conversion best practices, procurement requirements and regulations, compliant product databases, and vendor liaison.

- National Association of State Information Resource Executives (NASIRE).

NIST is a member of the National Association of State Information Resource Executives (NASIRE) and is active in their year 2000 subgroup.

- World Wide Web page on the Year 2000.

NIST hosts an Internet Web page designed to provide up-to-date information on standards and testing aspects of the year 2000 issue. Thousands of users have found white papers, software, contacts, and links to many other informative web sites. (See Web site <http://www.nist.gov/y2k>.)

- Software developed at NIST

NIST has developed a computer program that will assist organizations in determining how extensive their year 2000 problem will be. The program is in the public domain and is available free to anyone by downloading it from the NIST Website. It is used only as a means to measure the need an organization has. This software resulted from efforts to verify estimates of cost and system sizes that were published in the trade press during initial public response to the year 2000 problem in 1996.

NIST has also developed a reference data set generator that contains the correct calendar dates, ordinal dates, day of the week for each day, Julian day number, and leap year indicator. This information can be used to check the results of date computations produced by application programs. The software is available on the NIST Website.

A third software product that was initially used in general software debugging and testing has been applied to the year 2000 testing effort. Called Unravel, the software is used to search out the effects of software changes on particular date variables within programs and to correct software errors. Blair and Associates, a high-tech engineering firm of Hanover, MD, incorporates the NIST software in their commercial year 2000 product.

- Year 2000 Certification Criteria

NIST has been invited by Dr. Paul Strassmann, former Director of Defense Information at the Department of Defense, to assist and advise in developing a certification definition and process for industry to use in determining "good practices" for certifying year 2000 testing activities. Dr. Strassmann is working with the Software Test Assurance Corporation (STACorp), which is funded specifically for this purpose by agreement from 11 of the largest insurance companies in the United States. A draft document has been released with the next version scheduled for May 1998.

In summary, the National Institute of Standards and Technology is active in disseminating knowledge and tools that will help other government agencies, industry, and the international community address the year 2000 problem.

Other Commerce Activities

Since we live in an automated information technology world with inter-linked and interdependent systems on a global scale, the International Trade Administration (ITA) has prepared an information statement for its domestic and international field offices. The statement is intended to raise awareness in these organizations of the year 2000 problem so that they can tackle the problem in their own offices, but more importantly, so that they may advise and alert their clients, commercial organizations that are seeking to do business abroad. ITA plans other promotional activities to reach out to the international business community, particularly in countries where year 2000 efforts are not well developed.

Selected operating units are working with their international counterparts through existing international organizations to address year 2000 compliance. For instance, the Patent and Trademark Office is working with the World Intellectual Property Organization and the National Oceanic and Atmospheric Administration is involved with the World Meteorological Organization.

The National Telecommunications and Information Administration (NTIA) is positioned to reach out to the telecommunications industry to promote year 2000 awareness and to speed system conversions. NTIA will participate on the Telecommunications Subcommittee of the President's Council on the Year 2000 Conversion. The Economic Development Administration and the Minority Business Development Agency (MBDA), working with the Small Business Administration, will reach out to the business community through their existing networks of contacts. Specifically, MBDA, in collaboration with NIST, is preparing an electronic training package on the subject of electronic commerce, a component of which will address the year 2000 issue. The training package will be available to MBDA's base of 60,000 clients.

The Department of Commerce has responded to numerous items of correspondence from businesses, citizens, and other interested parties regarding the Federal Government's management of the year 2000 issue. We have provided responses addressing the writers' particular concerns and, more generally, raising the level of awareness regarding year 2000 issues.

Finally, at John Koskinen's request, the Department of Commerce will reach out to the Nation's insurance industry to do whatever we can to help raise the industry's level of awareness of the importance of the year 2000 problem and of the need to devote appropriate resources to its resolution. We will help this key component of the national economic infrastructure to meet the year 2000 challenge.

Conclusion

The Department of Commerce recognizes that the year 2000 problem is serious and poses a unique challenge to our country and the global economy. Our goal is to ensure that the U.S. economy will not suffer undue interruption.

Our internal management of the year 2000 program is strong and active. I noted earlier the critical role the Department plays in this Nation's economy. Many of the systems that allow us to detect severe storms and issue warnings, to gather key economic data, and to provide industry with measures and standards are fixed and being independently tested. Other important systems are still being renovated or replaced. Though we recognize that much work remains and that we must maintain continued management focus on the year 2000 issue, we are cautiously optimistic about a successful resolution of the year 2000 problem for the Department of Commerce.

As part of Commerce's mission to help sustain a healthy economy in the United States, we are also keenly interested in promoting year 2000 awareness and offering year 2000 assistance within the global business community. We have already undertaken a number of outreach, research, and guidance activities and will continue to expand our year 2000 efforts in the business community as a whole. As a member of the President's Council on the Year 2000 Conversion and as Deputy Secretary of the Department of Commerce, I will champion year 2000 awareness and conversion activities within

Commerce and throughout the global economy.

Statement of
Raymond G. Kammer
Director
National Institute of Standards and
Technology
Technology Administration
U.S. Department of Commerce

Before the
House Committee on Science
Subcommittee on Technology
September 23, 1999

Chairwoman Morella and Members of the Subcommittee, I am very pleased to be here to share with you some of the work the National Institute of Standards and Technology is doing to improve the competitiveness of America's smaller manufacturers.

For nearly a century, NIST has been working with companies of all sizes and with industries of nearly every type to develop and apply technology, measurements, and standards. In fact, as you well know, Congresswoman Morella, the importance of manufacturing is singled out in the report for the 1901 legislation that established my agency and we have it engraved in stone on the wall of our main lobby. The quote reads: "... no more essential aid could be given to manufacturing, commerce, the makers of scientific apparatus, the scientific work of the government, of schools, colleges and universities, than by the establishment of the institution proposed in this bill."

Manufacturing is critical to the nation's economy. Overall it provides nearly 20 percent of the nation's GDP, 17 percent of all jobs and 24 percent of all wages.

Since smaller manufacturers -- those with 500 employees or less -- make up almost 99 percent of all U.S. manufacturers, produce more than half of our value-added goods, and employ about 12 million Americans, they are both the foundation and the future of American manufacturing. It is clear that it is in the best interest of the United States to promote a strong and healthy base of small manufacturers.

As you know, 1999 has been declared the "Year of the Small Manufacturer" by the Secretary of Commerce and endorsed in a resolution by the National Governors' Association at their February 1999 meeting. In addition, President Clinton declared this week, the week of September 19-25, 1999, as Small Manufacturing Week.

To raise awareness of the technological needs of the nation's smaller manufacturers and to gather first-hand perspective, NIST, in partnership with the National Association of Manufacturers and the Modernization Forum, brought together more than 150 smaller manufacturers from across the country in the first National Manufacturing Summit held yesterday here in D.C. I am pleased that Jerry Jasinowski, President of NAM, is here today to deliver the findings from the Summit -- and that two small manufacturers involved in the Summit are here to discuss technology related needs first hand. Also I would like to thank the Subcommittee for sponsoring an exhibit from the summit in the foyer of the Rayburn Office Building.

I would like to quickly touch on some of the areas highlighted at the Summit.

- **Electronic Commerce (eCommerce)** – eCommerce can provide small manufacturers with a tool to improve productivity; find and retain new customers, suppliers, and other business services; and expand operations into new markets. Many casual observers simply equate eCommerce with on-line sales. However, small manufacturers who take full advantage of the potential of eCommerce use it to interact with customers, suppliers, the public, and external support functions such as payroll, utility services, and employee training.
- **Workforce** – The ability to attract, retain and effectively engage talented and productive people is a primary force influencing business strategy and business success. These "people practices" issues are as relevant for small manufacturers as they are for Fortune 100 companies. Indeed, small companies face numerous challenges in implementing effective people strategies and linking them to their business strategies.
- **International Trade** – Exports are a critical component of America's economic health: nearly 11 percent of the nation's GDP in 1997. The vast majority of American manufacturers who export are smaller enterprises with fewer than 500 employees. Many smaller firms do not have a strategic plan for exporting and do so on an occasional or sporadic basis.
- **Sustainable Manufacturing** – As we enter a new millennium, increasing global demand for consumer products and decreasing reserves of raw material are driving changes in manufacturing.

America's smaller manufacturers have a great opportunity to adopt new technologies that improve performance while limiting consumption.

An agency of the Commerce Department's Technology Administration, NIST occupies a unique niche in the nation's technology infrastructure. It is helping to build an essential foundation for technological progress and industrial growth through technical services and tools, and industrial modernization assistance, quality and performance improvement efforts, and risk-sharing incentives that motivate U.S. companies to pursue next-generation manufacturing technologies.

Many of the programs at NIST serve as resources to improve the technological advantage for the nation's manufacturing sector while partnering with industry to ensure the project meets the customer's needs.

Manufacturing Extension Partnership

A NIST program that provides assistance to small manufacturers is the Manufacturing Extension Partnership. MEP is where the "rubber meets the road" in providing hands-on assistance to the nation's 385,000 smaller manufacturers. Over the last two decades, these small firms have generated about three-fourths of all new manufacturing jobs and account for 55 percent of all value added in manufacturing.

Yet, many smaller manufacturers have been slow to adopt modern production technology and business best practices. Productivity growth has trailed that of their larger counterparts, creating a gap that threatens future competitiveness. Many factors, from limited investment capital to lack of information to pressing day-to-day demands on management, underlie this widely recognized weakness in a strategically important part of the nation's industrial base.

Until very recently, however, this problem drew only a small, fragmented response. Through the MEP network of local extension centers, each one linked to public and private organizations with complementing expertise, smaller manufacturers now have access to comprehensive sets of technology and business assistance. MEP centers have provided services to more than 77,000 smaller manufacturers. About half of these client firms employ fewer than 50 people, and nearly two-thirds employ fewer than 100. By the year 2001, MEP anticipates that affiliated centers will be delivering technical assistance to 10 percent of the nation's smaller manufacturers each year.

Created to fill the gaps in providing the technical and business services needed to improve the competitiveness of smaller firms, MEP currently has more than 400 locations serving smaller manufacturers in all 50 states, the District of Columbia and Puerto Rico. To help provide these services, MEP partners with a broad range of organizations, including state and local governments, other federal agencies, industry, non-profit groups, and educational institutions.

Even though MEP is still maturing, it quickly is becoming recognized as a vital federal-state partnership that is helping thousands of small firms improve competitiveness, increase profits, and enhance productivity.

Philip Shapira at the School of Public Policy, Georgia Institute of Technology, recently said, "Systematic evaluation studies have confirmed that the MEP is having a positive effect on businesses and the economy."

Here are the results of some of these studies:

- The U.S. Census Bureau surveyed more than 4,400 firms served by NIST MEP centers in 1997. These companies reported an increase in sales of \$236 million, a reduction of \$31 million in inventory, and a savings of \$24 million in labor and materials. They also invested more than \$193 million in modernization and created or retained 6,755 jobs.
- An analysis by the U.S. General Accounting Office found that a substantial majority of firms

using manufacturing extension services improved their productivity, product quality, customer satisfaction, profits and other critical facets of their business.

- A five-year study of 1,559 MEP client companies by the Center for Economic Studies at the U.S. Census Bureau found that a conservative estimate in the growth of value-added per employee at MEP client firms is \$2,334 as compared to \$508 for non-clients.
- Many compelling accounts of MEP's contributions come from individual centers. For example:
 - The California Manufacturing Technology Center recently reported a return on investment of 294% during a three-year period. The center also reported that as a result of collaborations in 1998, 131 clients created or retained more than 1,300 jobs, increased revenues by \$56.3 million, and created tax benefits totaling almost \$34 million to local, state and federal governments.
 - A study of the New York MEP found that the state's \$5.3 million investment in the program generated an additional \$227 million of value-added income in the state between 1995 and 1997 and created 2,600 jobs.

While these data are impressive, nothing brings these numbers to life like the stories of the small manufacturers who have worked with MEP centers to improve the way they do business. Here are a few:

- Red River Hardwoods, located in Clay City, Kentucky, was having a serious problem with a clogging dust collector which frequently halted production for up to two hours a day. Terry Field, president of the 55-employee lumber mill, turned to the Kentucky Technology Service for help in correcting the problem. After implementing changes to the dust collection system recommended by KTS, Red River Hardwoods cut production downtime by more than 50 percent, increased production capacity by 25 percent and saved approximately \$15,000 a year.

Field said, "The Kentucky Technology Service ... worked closely with my firm to resolve a problem ... This type of technical service must be available to small companies at an affordable price for us to remain competitive and grow."
- Mar-Mac Wire, Inc., located in McBee, SC, manufactures quality wire products for a variety of industries. But, the cleaning process of stainless steel wire was creating a hazardous waste that was expensive to dispose. A field agent from the South Carolina Manufacturing Extension Partnership asked the Oak Ridge National Laboratory for help in evaluating the waste. The recommendation was an inexpensive filtering procedure which would remove the hazardous chromium particles and save the company \$250,000 in disposal costs.
- The Montalvo Corporation of Portland, Maine, makes tension systems for equipment in the converting and packaging industries. Because the company relies heavily not only on its manufacturing and servicing equipment, but also its business computer systems, Montalvo asked the Maine Manufacturing Extension Partnership for help in determining whether it was at risk from the year 2000 computer problem, also called Y2K or the "millennium bug." "Thanks in large part to the MEP Y2K tool, we are now as confident as we can be that the Year 2000 bug will not interfere with our operations," said Ed Montalvo, president and one of the company's managing directors.

Since its modest start in 1989 as an experimental program, MEP has evolved into a productive force for industrial modernization. It maintains its local focus, while realizing economies of scope and scale in the design and content of technical assistance programs and resources. Funded with federal, state, and local dollars, all MEP affiliated centers- are non-profit organizations. All MEP centers are locally staffed and operated—organized to be responsive to the particular technical needs of an area's manufacturing sector.

As the federal partner, NIST concentrates on making the whole greater than the sum of its parts. For

example, NIST works to strengthen system capabilities in areas strategically important to smaller manufacturers. Right now, MEP is galvanizing resources and expertise to help smaller manufacturers, like the Montalvo Corporation, effectively tackle the "millennium bug." Through its Y2K Self-Help Tool, which is available in English, Spanish, and several other languages; a help center and a web site; as well as informational and educational materials, MEP is helping thousands of small businesses address this potential problem. Through an alliance with the U.S. Department of Agriculture, the U.S. Small Business Administration, and others, MEP is helping not only small manufacturers, but any small business avoid Y2K problems. MEP's reach and impact have been impressive, demonstrating what a federal-state-local-private sector partnership can accomplish.

Other network-wide MEP assistance includes:

Sustainable manufacturing. With affiliates across the country, the U.S. Environmental Protection Agency, and other partners, MEP is developing and testing tools that will help small manufacturers reduce waste, emissions, and inefficiencies as well as the burdens of complying with environmental regulations. In center-conducted assessments, difficulties encountered when responding to environmental regulations and permitting requirements often rank among the top challenges cited by manufacturers.

Technology and the workforce. In MEP's assessment of challenges facing smaller manufacturers, workforce training is second only to the constant requirement to reduce costs while increasing quality. Human resources projects now account for 10 percent of all MEP technical assistance activities. MEP staff and affiliates are working with the U.S. Department of Labor, community colleges, and other organizations to further build system-wide capabilities to help firms upgrade worker skills and devise high-performance workplace strategies most appropriate for their businesses and workforces.

Anticipating needs and challenges. MEP also is designing new initiatives to help smaller manufacturers acquire the capabilities necessary to compete successfully in the 21st century. Current trends indicate that the supply-chain optimization efforts of major original equipment manufacturers will be especially critical to the long-term performance and business health of smaller manufacturers.

MEP is working with smaller manufacturers to help them gain the organizational, logistical, and operational skills required to perform effectively and profitably in the emerging era of supply-chain-centered competition.

Measurement and Standards Laboratories

In every industry, firms of all sizes and types rely on a portfolio of supporting, generic technologies that are integral to a company's manufacturing capabilities. These indispensable tools range from tables of scientific and engineering data to statistical quality-control methods to measurement techniques for ensuring that one coordinated measuring machine's micrometer is calibrated with another machine's micrometer.

NIST is a key supplier of such infrastructural technologies and services. The results of NIST research lead to industry-accepted test and measurement methods, process models, interface standards, and other useful tools. In industries ranging from electronics to radiopharmaceuticals and from chemical processing to aerospace, these tools contribute to effective operations and quality products. The capabilities that they support often set the technical limits on what can be accomplished on the factory floor, in the research and development laboratory, or with suppliers and customers.

For example, we distribute about 350 NIST-developed Standard Reference Materials, the equivalents of certified "rulers" that firms use to check the accuracy of their own measurements. In manufacturing SRM's support motor-vehicle production at nearly every step of the process, from the manufacture of

sheet metal, windshields, tires, and transmission gears to final assembly.

In the optical-fiber industry, technical contributions made by NIST's Measurement and Standards Laboratories serve as the basis for more than two dozen standardized measurement methods that U.S. producers credit with helping them to maintain their world-leading market share.

NIST's technical assistance helps manufacturers build capabilities that underpin their competitive performance. Consider our work with American Superconductor Corporation, a small but rapidly growing company in Westborough, Massachusetts. Up against the likes of Germany's Siemens and Japan's Sumitomo, this 220-employee firm is positioning itself to be a major player in the emerging global market for wires, energy-saving motors, and other products made with high-temperature superconductors.

Discovered in the late 1980s, this class of ceramic materials conducts electricity without resistance--even at relatively high temperatures. But the materials are hard to work with, which has confounded commercial development efforts. They're extremely brittle and minute flaws can disrupt current flow. Exacting materials-characterization techniques and quality-control measurements are a must.

American Superconductor turned to the NIST laboratories to help it make highly accurate measurements of the crystalline texture of the superconducting ceramic. The company wanted to make these advanced measurements with a relatively ordinary piece of equipment that it already owned. Our researchers met the challenge. They developed measurement techniques and special analysis software that quickly made optimal use of data obtained with a conventional X-ray diffractometer.

Measurement needs are growing and diversifying in every area of manufacturing. In precision manufacturing, a label that applies to a growing portion of the discrete parts industry, dimensional tolerances are shrinking to ever-smaller fractions of a split hair. Meanwhile, the shapes of parts and products are growing more complex. In the continuous-process industries, manufacturers must continuously raise the threshold for levels of selectivity and specificity. In fact, all manufacturing industries are being driven to improve processes, reduce waste, and raise quality. At the same time, emerging technologies present tantalizing prospects for novel products and processes, but they also introduce new measurement challenges that must be overcome before these opportunities can be fully realized.

Today, we are putting greater emphasis on the infrastructure needed to support advanced computing and communications technologies and, just as important, the capabilities that they enable. This includes what some are calling *E*-Manufacturing.

One thrust of this wide-ranging work is developing prototype standards, tests, and other tools for interoperability. Tools that enable the almost myriad elements of information technology, the hardware and the software, to work together efficiently. This is a critical need.

Consider, for example, that lack of interoperability costs the U.S. automotive industry alone about one billion dollars a year—and that's a conservative estimate. Part of the solution to this costly problem is an international standard called STEP, which stands for the Standard for the Exchange of Product Model Data.

NIST has worked for over a decade with hundreds of firms and thousands of people from around the world to develop STEP. It's a new kind of standard, designed to evolve and grow with the needs of industrial users of information technology. STEP enables direct computer-to-computer exchanges of a growing variety of product data--all the way from design to after-sale support, even recycling.

Elements of STEP have been adopted by makers of design software, and the manufacturers who use the standard are realizing significant benefits, from major improvements in the reliability of data exchanges to substantial savings in the purchase and implementation of computer-aided manufacturing systems. Small manufacturers are a vital part of this equation.

At NIST's National Advanced Manufacturing Testbed, teams of researchers have worked to solve measurement and standards issues that impede companies and industries from making the most of their information technology, individually and collectively.

The NAMT is a distributed, multiproject testbed built on a state-of-the-art, high-speed computing and communications infrastructure—the research counterpart to the distributed and virtual enterprises envisioned for 21st-century manufacturing. It links people—as well as specialized facilities and resources—at sites around the country as they tackle process-specific challenges and opportunities. Though focused on specific problems and needs, all NAMT projects have been aimed at modular solutions that are integratable elements of larger systems. Now, NIST is moving ahead with planning the next incarnation of this testbed to best meet the information technology-driven needs of U.S. manufacturers, including small manufacturers.

In consultation with industry, NIST is stepping up efforts in key technology areas likely to have a major impact on future manufacturing capabilities. On behalf of U.S. industry, it also is intensifying and broadening its technical activities in the international standards arena, which greatly influences the ability of the nation's manufacturers to sell their products in foreign markets. These are concerns for U.S. manufacturers, regardless of size, as we move into the next century.

Advanced Technology Program

The rapid pace of innovation and change in the global economy has affected every aspect of business, nowhere more so than manufacturing. What was good enough yesterday is not good enough today. The NIST Advanced Technology Program helps deliver the innovations that U.S. manufacturers need to stay competitive.

Since its start in 1990 as a small experimental program to promote "commercializing new scientific discoveries rapidly" and "refining manufacturing practices," the ATP has promoted innovation in industry processes and technology, including important advances in manufacturing.

The ATP helps bridge the gap between the laboratory and the marketplace and stimulate partnerships among companies of all sizes, universities and the whole R&D enterprise.

- An early ATP award to the Auto Body Consortium sparked a landmark R&D project that brought together the initiative and talents of eight small and mid-sized suppliers to the auto industry and two universities, with matching funds from General Motors Corp. and Chrysler Corp. The consortium developed a suite of innovative processes and tools that improve the quality of vehicle body assembly. The results are being implemented in auto plants around the country and independent analysis done by CONSAD Research Corporation estimates savings to consumers and car makers of up to \$650 million annually on maintenance which will stimulate a multi-billion-dollar increase to the U.S. economy.
- Another ATP project coordinated by the National Center for Manufacturing Sciences brought together nine companies ranging in size from very small to large to develop new drive and control technologies for machine tools – the machines that build other machines. Lest this sound rather ordinary, I might point out that no fewer than three individual developments from this project have received "R&D 100" awards for significant technological innovation. Just *one* innovation from this project can save the auto industry more than \$6 million annually in producing a single part. Multiply that by many parts and many industries.
- Other ATP awards have allowed a small innovative company called Autospect to develop a unique – and badly needed – technology for measuring the thickness of wet paint on metal; enabled the Ingersoll Milling Machine Company to develop a new class of light-weight, high-precision machine tools; and made it possible for small Saginaw Machine Systems, Inc., to develop a high-performance control system for machine tools that dramatically improves machining accuracy.

At a time when companies are concentrating more of their research and development efforts on the predictable, the incremental, the nearly immediate; at a time when – as the Council on Competitiveness recently reported – “less and less” private-sector R&D “is spent on longer range research, the kind of research that ensure continued economic growth,” the ATP encourages companies large and small to focus on the long term, to look beyond the next one or two product cycles and to invest the resources required to convert promising, but unproven, emerging technologies into new products and manufacturing methods.

ATP projects in manufacturing run the gamut from sheet-metal industries to electronics, and from the literal cutting edge – high-performance tooling – to sophisticated software to streamline and manage manufacturing enterprises.

Since 1990, the ATP has selected at least 58 R&D projects that could directly impact the future of manufacturing in the U.S. That translates to about \$170 million in industry cost-sharing and investment in advanced manufacturing research matched by an ATP investment of about \$164 million. Those projects involve more than 200 companies, universities, non-profit research organizations and federal laboratories. More than 70 of the participants are small businesses.

With industry, ATP regularly surveys the technology horizon for long-term opportunities that, down the road, may pay significant dividends in terms of U.S. competitiveness and economic growth.

Baldrige National Quality Program

NIST’s Baldrige National Quality Program focuses on quality and performance excellence of American organizations, including manufacturers.

Since its creation in 1987, the Baldrige National Quality Program has played an important role in helping the United States regain its competitive edge and its world-class quality ranking among nations. But, the competitive race is far from being won. For manufacturers, in particular, quality now is a mandate, not an option. Companies worldwide recognize the competitive advantages achieved through quality and performance excellence. To attain and retain market leadership in the next century, U.S. companies will have to improve continuously.

Of the 34 companies that have won the Baldrige Award, 24 are manufacturers. These include some of the nation’s largest firms, such as Motorola and Eastman Chemical Co., and smaller manufacturing businesses, such as Texas Nameplate Co., Trident Precision Manufacturing and Wainwright Industries. For all, the Baldrige Award process has proven to be an effective tool for continuous improvement.

Following the Baldrige guidelines continues to pay performance improvement dividends to firms that maintain their commitment to quality. Consider a few examples:

Since 1995, Texas Nameplate Company (1998 small business winner) has increased the number of orders shipped by 16 percent and raised its on-time delivery record from 95 to 98 percent.

Wainwright Industries, Inc. (1994 small business winner) has reduced its customer reject rate by 91 percent and cycle time by more than 90 percent. It used the Baldrige framework to drive more than 10,000 quality and process improvement suggestions implemented each year since 1994.

Nearly 25 percent of Eastman Chemical Co.’s (1993 manufacturing winner) sales come from new or improved products developed in the last five years.

Since winning the Baldrige Award in 1988, Globe Metallurgical, Inc. (1988 small business winner) has experienced a 204 percent increase in revenues and a 310 percent increase in profits.

Thousands of organizations use the Baldrige Award criteria to assess their own operations. Almost two million Baldrige Award criteria have been distributed and thousands more downloaded from the NIST web site. Annually updated and enhanced by leading quality and business experts, the criteria serve as

very functional tools—as scorecards to size up performance and identify opportunities for improvement.

Further fueling the drive for quality improvement, the Baldrige Award has become a widely emulated model—the standard for performance excellence. Not only do more than 40 states have award programs, but also, more than 25 international quality awards have been established. Most resemble the Baldrige Award, including one launched by Japan in 1996.

NIST is mapping out ways to strengthen awareness of the award program and criteria among smaller manufacturing businesses and other similarly sized firms. As Texas Nameplate, Trident and Wainwright demonstrate, such companies can benefit greatly by implementing the Baldrige framework.

Conclusion

As I said at the beginning of my remarks, manufacturing is important to us at NIST. It is not only engraved on our wall, it is part of our heritage. For almost 100 years it has been our job to help the nation's manufacturers, both large and small, create and capitalize on technological opportunities. I am very proud of what we have accomplished and am excited about beginning our next century of service to American industry.

Thank you. I will be pleased to answer any questions.

**Statement of
Raymond G. Kammer
Director
National Institute of Standards and Technology
Technology Administration
U.S. Department of Commerce**

**Before the
Subcommittee on Technology
Committee on Science
U.S. House of Representatives**

March 30, 2000

Madam Chairwoman and members of the subcommittee, I would like to thank you for this opportunity to testify today on "The Changing Face of Healthcare in the Electronic Age". The National Institute of Standards and Technology (NIST), an agency of the U.S. Commerce Department's Technology Administration, plays an important role in the development of standards, tools, and technologies for the healthcare information infrastructure. Given the Subcommittee's topics of interest for today's hearing, my testimony will focus on three topics: (1) the barriers to integrating information technology into the healthcare industry; (2) the role of the Federal government in developing standards and related security measures that will assist the healthcare industry in implementing quality information technology strategies; and (3) the development of new information technologies that will reduce healthcare costs, improve quality, and increase global market share of new and improved products and services.

I want to note at the outset that the U.S. Department of Health and Human Services plays a major leadership role in this area. As many of you are aware, the Health Insurance Portability and Accountability Act (HIPAA) of 1996 provides a national framework for bringing the benefits of IT to healthcare in the U.S. Enacted with the support of the health care industry and with bipartisan support in Congress, HIPAA directs the Secretary of Health and Human Services (HHS) to adopt national standards to support electronic interchange and administrative simplification in health care, along with national standards to protect the confidentiality and security of health information.

The industry estimates that the implementation of these standards could save as much as \$9 billion annually in administrative costs. HHS has already issued notices of proposed rulemaking that outlined proposed national standards for a variety of electronic administrative transactions in health care such as claims processing, as well as proposed national standards for the industry that deal with the protection of health information privacy and security. Final standards are expected later this year. NIST has worked with HHS on the proposed security standard, with a primary focus on electronic signatures, and we will continue to work with HHS on this issue. In addition, HHS agencies such as the National Library of Medicine and the Agency for Healthcare Research and Quality have long established programs that support research in information technology and its applications to health and medical care.

As we move into the 21st century, we continue to see explosive growth in information technology (IT) worldwide with unprecedented advances in the processing power, transmission speed, and bandwidth of our information systems and networks. Global communications and electronic commerce are fueling the U.S. economy and fundamentally changing the ways government and industry does business. The healthcare industry, like other major sectors of the U.S. economy, will also be experiencing unprecedented change as it begins to take greater advantage of these new technologies to increase productivity and improve the quality of service. The new technologies will dramatically alter our healthcare system as it currently exists today.

Medical spending in the U.S. exceeded \$1.1 trillion in 1998, and conservative estimates figure 20% of today's healthcare costs are related to the processing of information. Effective, secure, and reliable

information technology systems will deliver substantial cost savings while also strengthening this important sector of the economy. Within the next few years, we will likely see a significant increase in the transition from the traditional paper-based healthcare system to a system that relies more and more on electronic-based medical records for managing patient information. Electronic-based medical information, both clinical and billing, will be used by both healthcare providers and patients. The Internet and associated web-based technologies give healthcare providers and patients an effective vehicle for communicating and sharing critical information. Information sharing and a reduction in paperwork through a fundamental reengineering of the healthcare system have the potential to help contain costs and provide timely, accurate, and secure access to medical information. Since Americans are looking for quality, cost-effectiveness, and personal satisfaction from their healthcare providers, and with a new healthcare delivery structure emerging to enable this, the work NIST is performing through our Information Technology Laboratory and the Advanced Technology Program uniquely positions us to assist in this transition.

While the new technologies provide great opportunities for creating a better healthcare system, several barriers exist to the effective integration of the technologies into the industry as whole. One obvious barrier is concern about the security and privacy of the medical information being processed, stored and transmitted within healthcare computer systems and networks. At the top of the list in this area is our ability to preserve the sanctity of the patient's medical record. We must, in the new electronic world, be able to ensure that a patient's confidential medical information remains private and secure. We must also be able to protect sensitive medical information needed by healthcare providers to conduct their daily business---such activities as the transmission of physicians' prescriptions to pharmacies, the processing of patients' insurance information, and the storage of important medical statistics and case histories. All of these activities, conducted on computer systems and over networks, call for protections similar to or even greater than those provided in the paper-based world.

To that end, healthcare professionals face a difficult challenge---that is, finding the right IT products that can offer cost-effective and appropriate protection for healthcare systems and networks. In today's information technology marketplace, there is a plethora of commercial products with different capabilities and limitations. Consumers are generally left with a confusing set of choices as they attempt to answer the following question: How do I choose the right products for my IT system to ensure I get the features I need with the appropriate level of security and trust? Trust is a measure of the confidence or assurance consumers have that particular products they select will perform reliably and to specifications even in the face of intentional or direct attacks. Building more secure healthcare systems starts with the use of fundamentally sound components---that is, the individual IT products.

NIST is taking a proactive role in working with the healthcare community to help overcome some of the barriers previously mentioned. I would like to discuss several NIST programs and initiatives in the area of IT security standards, IT product testing and validation, and cryptography/public key infrastructure that we believe can have a positive impact on the overall security of healthcare IT systems.

One of the most important initiatives championed by NIST during the last six years is the development of the Common Criteria for Information Technology Security Evaluation, the first truly international standard for IT security. The Common Criteria, or ISO/IEC Standard 15408 as it is now known, offers consumers and IT providers a uniquely flexible and extensible approach for defining security requirements in commercial IT products and systems. In addition to security specification, the Common Criteria provides a rigorous and comprehensive approach for testing IT products and systems using a common testing methodology. Thus, the Common Criteria provides an internationally recognized basis for specifying and testing the security features in a wide range of technologies including operating systems, database management systems, firewalls, smart cards, telecommunications switches, network devices, middleware, and applications---technologies that are important to building more secure healthcare IT systems.

In addition to having a common language to specify IT security requirements in commercial products, it is also important to have effective ways to measure what IT providers have produced. In 1997, NIST and the National Security Agency (NSA), in fulfilling their respective computer security responsibilities established the National Information Assurance Partnership (NIAP). The partnership combines the

extensive IT security experience of both agencies to promote the development of technically sound security requirements for IT products and systems and appropriate measures for testing those products and systems. The long-term goal of NIAP is to help increase the level of trust all consumers, including healthcare consumers, have in their information systems through the use of cost-effective security testing and validation programs. In meeting this goal, NIAP seeks to:

- promote the development and use of evaluated IT products and systems;
- champion the development and use of national and international standards for IT security;
- foster research and development in IT security requirement definitions, test methods, tools, techniques, and assurance metrics;
- support a framework for international recognition and acceptance of IT security testing results; and
- facilitate the development and growth of a commercial security testing industry within the U.S.

To help patients, physicians, and other healthcare professionals ensure the confidentiality of medical information and also guarantee the identity of those they communicate with in an electronic environment, new security mechanisms must be employed. The handwritten signature and locked file cabinet are no longer sufficient in a world with electronically maintained healthcare forms and patient records.

Cryptographic techniques supported by a public key infrastructure, or PKI, offer some of the most promising solutions. Public key cryptographic techniques for digital signatures can provide assurance that electronic information, such as an e-mail message, has not been modified. When used with a PKI, digital signatures can be used to verify the signer of the electronic message as well. When combined with techniques for key management and encryption, healthcare professionals can establish secure communications between senders and recipients. This helps ensure the confidentiality of patient information as it is transmitted across the Internet. NIST is a leader in the development of a Federal Public Key Infrastructure and is working with industry to develop PKI technology. We have also led research and development efforts to support the creation of large and complex PKIs, worked with industry to develop government and Internet standards for PKI, and participated in ongoing PKI interoperability testing efforts.

In addition to its efforts in the PKI area, NIST continues its leadership role in the specification of cryptographic techniques needed by Federal agencies and industry. The Secretary of Commerce has approved a Federal Digital Signature Standard and a Secure Hash Standard, which support digital signatures and have also begun the process of standardizing key management techniques to support the establishment of secure communications. We are also working with industry to develop a new encryption standard, known as the Advanced Encryption Standard (AES). Our goal is that the AES can be used to protect sensitive information, such as healthcare provider and patient information, for the next thirty or more years.

I would now like to address some specific healthcare IT security initiatives. Both NIST and NIAP currently have complementary projects to work with the healthcare industry to find more effective ways to define security requirements for healthcare IT systems and to help healthcare consumers gain confidence that IT providers have produced the IT products and security features they need.

The first initiative supported by NIAP was the establishment of an industry-led healthcare security forum to bring healthcare consumers and providers together. In general, the participants discussed security requirements for healthcare IT systems, and the potential for developing specific sets of security requirements, or protection profiles, using the international standard Common Criteria. On November 18, 1998 an initial public meeting was held at NIST to seek the healthcare industry's interest in establishing such a healthcare security forum. The purpose of the meeting was to inform and educate the healthcare community about NIAP and the Common Criteria and to seek industry's interest in developing specific protection profiles for healthcare enterprises. The initial feedback from the forum attendees was very positive. Privacy and the protection of medical information were major industry concerns as well as how organizations could show compliance with the Health Insurance Portability and Accountability Act (HIPAA) of 1996 and emerging Department of Health and Human Services (HHS)

requirements.

In listening to the concerns of the healthcare industry, it appeared that the Common Criteria paradigm for specifying IT security requirements and the NIAP IT security testing program offered a promising approach for supporting organizations' efforts to meet healthcare laws and policies. It also appeared that the Common Criteria paradigm might provide a common structure to express healthcare consumer and healthcare provider security requirements and a method for comparing security-enhanced IT products produced by vendors.

In a related effort and based on the feedback from the healthcare security forum, NIST's ITL began an intramural research project in October 1998 with our Advanced Technology Program (ATP) to develop a methodology and healthcare security architecture for guiding construction of a family of Common Criteria-based protection profiles, or sets of security requirements, for healthcare IT systems. NIST wanted to demonstrate how healthcare providers could help address compliance with the security requirements articulated in top level healthcare policies or laws---that is, do the security features in particular IT products used in healthcare IT systems support the protection requirements?

Most of the Common Criteria efforts today focus on the development of generic security specifications, or protection profiles, for a particular product or product family, for example, operating systems, database management systems, firewalls, or smartcards. There has been little effort to date in developing protection profiles for an IT system supporting a specific community of interest, such as healthcare or banking. These systems-level profiles must support all functions in a particular business process area, (for example, patient billing, collection of clinical trials data, and insurance billing), and are therefore, more difficult to construct than the generalized, product-based profiles. The results of the NIST ATP research project are expected to provide a framework for defining healthcare security domains where specific protection profiles are needed, and to give guidance on how technology specific or product-level profiles, such as firewalls or database systems, can be incorporated to support the business's security objectives.

Another interesting aspect of the ATP project was the development of specific Common Criteria security requirements for processing Health Care Financing Administration (HCFA) data. In November 1998, HCFA published an Internet Security Policy (HISP) to provide guidelines on the appropriate use of the Internet to transmit Privacy Act-protected and other sensitive information. To incorporate the best industry practices for implementing the provisions of this policy and express them in a standardized language, a Common Criteria-based set of security requirements was developed. This set of requirements, or "functional package" as it is called, represents an aggregate of the security functional requirements expressed in Common Criteria language that captures the provisions of HCFA Internet Security Policy. This functional package can, in turn, be used by healthcare consumers and providers in creating protection profiles that specify IT security requirements for HCFA compliant products and systems. It also provides the necessary latitude for different IT providers developing systems to transmit/receive sensitive HCFA data, to implement the policy requirements through a variety of technical solutions.

Our Advanced Technology Program has played an important role in the emergence of healthcare IT technologies. The ATP has co-funded a suite of 32 projects with an estimated funding of approximately \$140 million in ATP funding matched by nearly \$140 million in industry funding. These projects were designed to develop critical information infrastructure technologies to enable enhanced, more fully integrated medical information systems across the healthcare industry, increasing accessibility and uniformity while greatly reducing costs and errors in handling medical information. The projects developed technologies for the development of an infrastructure for a private-sector-driven, nationwide information system, including:

- tools for enterprise integration, domain identification, and business process modeling;
- technologies to make such a system efficient and user friendly, including computerized-knowledge-based systems, digital libraries, and natural language processing; and
- applications that directly meet healthcare users' needs, such as clinical decision support systems and consumer health information and education systems.

As these projects mature, we are beginning to see progress towards the building of an information infrastructure for healthcare. Specifically, trends include: movement from proprietary to open systems; acceleration of the development and acceptance of standards; and building critical mass through cross-disciplinary teaming. Also, the economic benefits associated with many of these projects are beginning to accrue. These benefits include reduced healthcare costs, improved quality of healthcare, and an increase in global market share of new and improved products and services. I would like to highlight a few of these projects.

One of the ATP awardees, Belmont Research, Inc, developed technology to help researchers transfer, query, and mine complex health care data from a multitude of scattered clinical and administrative databases, without requiring changes to the existing databases. A new software product which incorporates some of the technology, TableTrans™ allows data managers and analysts to carry out database transformations and queries that are too complex for traditional tools, using a visual, step-by-step user interface. In addition to being useful in drug development, this software also had a further benefit in that it helped users identify Y2K data problems and convert data into a Y2K-compliant format.

Another successful project is a joint venture we co-funded with 10 participants led by the Advanced Technology Institute, formerly the South Carolina Research Authority. The focus of the project was to develop tools for healthcare information technology that would enable community care. For example, this project has greatly benefited healthcare delivery in rural areas. As way of illustration, consider Charleston Area Medical Center, a major healthcare provider in Southern West Virginia, which used results of this project to establish a teleradiology network to provide rural facilities access to a board certified radiologist 24 hours a day, seven days a week. This allows patients to stay close to their homes during treatment and greatly reduces the number of transfers and repeat exams required. Two years ago, during off-hours it took approximately 10 hours to receive a radiology report, frequently requiring the use of couriers to hand deliver films. What a dramatic improvement now, when a radiologist's interpretation is returned within 15 minutes of an exam! Plans are underway to expand the use of this technology to cardiology services and oncology services also. Another illustration of a tool developed under this joint venture to assist in healthcare delivery is that of remotely controlled, digital telepathology. This permits biopsy specimens taken at rural healthcare facilities to be examined remotely by a pathologist at a central site many miles away, within the clinically acceptable time frame of less than 15 minutes. This capability addresses the need of local healthcare facilities that cannot afford full time pathology services. Thanks to this technology, surgical procedures can be scheduled according to patient need and not according to pathologist availability.

The face of healthcare is indeed changing as we embrace this new information age. Another way it is changing through information technologies, which you may not have considered, is in advances in virtual reality for surgical training. In the past, simulation technology has not offered sufficient realism to mimic medical procedures, which typically have been learned through practice on cadavers, animals, and sometimes crude models. With co-funding from the Advanced Technology Program, a small company in Gaithersburg, Maryland, HT Medical Systems, Inc., has been able to advance medical simulation technology to a high level of realism at reasonable cost. They have developed the capabilities to model complex natural phenomena such as the cutting and bleeding of human tissues and the technologies for simulating minimally invasive surgery, including robotic tactile-feedback devices that replicate the "feel" of endoscopic and endovascular procedures. Several products have been commercialized based on the ATP-funded research. One of these, for example, combines visual and tactile elements to teach nurses the cognitive and motor skills needed to insert a needle properly into a vein - the most common medical procedure. To date, about 170 of these systems are installed in six countries. Research shows that this system costs less than plastic arm models and encourages more practice.

In summary, the barriers to effectively integrating IT into the healthcare industry do not seem to be insurmountable. We are making substantial progress in solving the difficult and challenging problems associated with the security of healthcare IT systems. NIST is actively engaging industry and employing its best technical resources to address the healthcare security and technology issues I have discussed in

my testimony today. We believe that NIAP, use of the new international IT security standard (Common Criteria), the emerging IT security testing program, and new technologies can provide significant help to healthcare consumers and providers in transitioning to this increasingly paperless environment. Making more informed product choices should result in more secure systems and help healthcare consumers and providers meet applicable security requirements. Thank you and at this time I would be happy to answer any questions the subcommittee might have

Karen H. Brown

Deputy Director

National Institute of Standards and Technology

Technology Administration

U.S. Department of Commerce

Before the

House Committee on Science

Subcommittee on Technology

June 22, 2000

Madam Chairwoman and members of the Subcommittee, I am pleased to appear before you today to discuss the role of the National Institute of Standards and Technology (NIST) in helping e-commerce thrive in the United States. As you know, NIST is an agency of the U.S. Commerce Department's Technology Administration.

We hear constantly about the growth and impact of e-commerce on the new economy and on our everyday lives. Everyone recognizes that e-commerce is big and getting bigger. Retail e-commerce gets a lot of press coverage, but the real impact of e-commerce is much broader than that. For example, business-to-business (or B2B) e-commerce activity is expected to pass one trillion dollars annually by 2003, compared to 108 billion dollars for retail e-commerce. I don't think I need to persuade you that the continued health and growth of e-commerce will be even more critical for our Nation and economy in the future.

The private sector is driving advances in e-commerce technology and use, as it should. So it is fair to ask: What is the role of the federal government in e-commerce? In particular, I would like to share my thoughts today on the role of NIST in e-commerce.

NIST's role in e-commerce is to work closely with the private sector to ensure that the e-commerce infrastructure is strong enough and flexible enough to enable the continuing growth and success of e-commerce. NIST provides unique tools to help industry build new e-commerce technologies and applications. We hear a lot of comparisons between the new "dot com" companies and the traditional "bricks and mortar" companies. To make analogy to the more traditional view -- which is more familiar to many of us who didn't grow up in the Internet age -- NIST provides the e-commerce "bricks and mortar" that industry uses to build new e-commerce "structures." However, in the e-commerce world, those "bricks and mortar" that NIST provides are not just physical things but also software, standards, and technical assistance. And industry uses the e-commerce "bricks and mortar" that NIST provides not just to build physical things, but also to provide services, software, and communications methods.

Let me be more specific about NIST's unique role in providing tools to the private sector to help e-commerce thrive. NIST provides three types of tools:

- Measurements and standards for the hardware, software, and networks that comprise the e-commerce infrastructure, ensuring that the infrastructure works effectively and can support continuing growth and change.
- Direct hands-on assistance, through the Manufacturing Extension Partnership, to American small

manufacturers who need help to thrive in the new e-commerce-driven economy.

- Co-funding of private sector research, through the Advanced Technology Program, to help develop the new technologies that will enable future advances in the e-commerce infrastructure and new ways of exploiting e-commerce and information technology.

I would like to tell you more about each of these three types of e-commerce tools that NIST provides.

Measurements and Standards to Enable E-Commerce to Thrive

First, let's consider how the NIST Laboratories provide the critical measurements and standards that enable the private sector to build the e-commerce infrastructure and ensuring that it can grow and change with future technical and economic advances.

For example, standards are critical to ensuring that the incredibly vast and complex Internet -- the network that is the backbone of e-commerce -- can function and grow. The Internet contains millions of computers, communications devices, software systems, and other components, each coming in a wide variety of different types. Without common standards, the Internet would be the ultimate Tower of Babel, with different components speaking languages not understood or compatible with the other components, or not even able to speak and hear on the same frequencies.

The NIST Laboratories play a key role in working with industry to develop the standards that ensure the smooth functioning of the Internet to enable e-commerce, and facilitate future innovation and competition. In the intensely competitive information technology and e-commerce world, industry relies on the neutral, technical expertise of NIST to help formulate industry-wide standards that will benefit ALL players and the whole economy.

Randall C. Whiting, when he was President and CEO of CommerceNet, made the case for NIST involvement clearly and concisely. He said:

"...Many of the most fundamental components of the Internet, upon which e-commerce is dependent, are not effectively managed, coordinated, standardized or developed. It is essential that there be a close partnership between industry and government to effectively address the many infrastructure, technology and process issues that will face e-commerce in the near future. Having an agency such as NIST in that role will ensure industry has a partner that 1) understands the demands of technology and business innovation, 2) is experienced in key infrastructure standards, 3) is independent of political motivations..."

I want to briefly mention some other specific areas where NIST measurements and standards are key to enabling industry to exploit e-commerce advances.

Security

Successful e-commerce depends on secure transmission of data such as credit card numbers, financial information, medical records, and other sensitive information. NIST is leading the global effort to develop the Advanced Encryption Standard, which will be used to ensure that encrypted sensitive data cannot be decoded by anyone but the intended parties. Typical of NIST standards activities, NIST has worked very closely with industry on AES to develop guidelines and ways to test new possible standards. Companies from around the world submitted candidate new standards to NIST for extensive public testing and analysis. When the testing is completed in a few months, the Secretary of Commerce will announce the proposed final encryption standard (there may be more than one) that will provide data security for the next 50 years, ensuring that sensitive information can be safely exchanged for e-commerce.

In addition to making data safe, e-commerce security also depends on accurately identifying who you are communicating with. NIST has been a leader in helping develop Public Key Infrastructure (PKI) standards that ensure accurate identification of the parties in an Internet transaction. NIST works closely with the industry-led Internet Engineering Task Force which helps develop PKI and other security

standards, and NIST works with many other private sector standards groups. NIST also developed a testbed where different private sector implementations of PKI can be tested to ensure that they work together effectively and are compatible with different hardware and software systems.

Conformance Testing

World wide web pages and applications are becoming much more complex. Rather than just text and pictures, complex interactive data exchange and software applications are becoming routine on the web for e-commerce, including such things as optimizing manufacturing processes, planning the best delivery routes along many different stops with different priorities, automatic ordering and billing, and many other applications. A powerful new web programming language called XML (eXtensible Markup Language) appears very promising for future generations of advanced web applications. NIST has worked closely with industry (including the OASIS consortium) to develop tools and methods to make sure that e-commerce applications using XML work effectively across all the different types of computers, software systems, browsers, and networks. NIST's XML Conformance Test Suite will enable industry to exploit the full range of possibilities for XML to greatly expand e-commerce applications.

Wireless Internet

Going wireless frees computers, palm devices, and other hardware from the mobility limitations of cables or fibers, and extends e-commerce to just about any environment imaginable: communications with trucks and planes en route, exchange of information at building sites, and many other applications. To help develop the communications standards that enable broad adoption of wireless technologies, NIST chairs an effort involving all the major industry players, the Institute of Electrical and Electronics Engineers (IEEE) Broadband Wireless Access Standardization committee. The importance and impact of such NIST efforts are reflected by a statement from Louis Olsen, Vice President of Technology Development for Taligent, Inc. Olsen said:

"Taligent supports the IEEE 802.16 broadband wireless access standardization effort [Chaired by NIST], which we believe will drive down equipment costs and create a framework for new innovation. This will allow us to roll out service faster to more areas and serve more customers. Standards will make wireless a real alternative for residential broadband access and expand the range of customers served."

Fiber Optics

Continued success of e-commerce will depend on an enormous increase in data transmission rates, and NIST is providing the measurements and standards that will ensure that the fiber optic backbone of the Internet will be able to deliver the needed capacity. Every U.S fiber manufacturer relies on special NIST fiber standards to ensure that different fibers can be spliced together effectively -- even tiny misalignments of two different fibers can dramatically impede data flow. NIST provides other standards and measurements that industry uses to ensure that fiber is manufactured with the tight tolerances needed to ensure proper quantity and quality of data transmission. And NIST is working closely with industry to develop the new measurements and standards to support a new technology called DWDM (Dense Wavelength Division Multiplexing) that will permit millions of different data streams to be jammed simultaneously into one fiber, vastly increasing the data capacity.

Making E-Commerce a Reality for Small Manufacturers: Manufacturing Extension Partnership

In addition to measurements and standards, the second major tool that NIST provides to support e-commerce is direct, hands-on assistance to help America's 385,000 small manufacturers thrive in the e-commerce economy.

The Washington Post noted recently that: "...small businesses today seem bewildered by sites vying to help them do e-business." A recent National Association of Manufacturers study found that more than

two thirds of manufacturers are not yet using electronic commerce to conduct business transactions. More than 50 percent of all supply-chain participants are small businesses. As supply-chains become increasingly driven by e-commerce, all parts of the chain will suffer if small manufacturers are unable to adopt e-commerce practices. At a recent manufacturing conference sponsored by NIST's Manufacturing Extension Partnership, one small manufacturer noted that he was quite comfortable deciding whether he needed to purchase a \$20,000 truck versus a \$50,000 truck, but when it came to selecting between a \$5,000 email server and a \$50,000 email server he had no idea how to approach the problem.

With centers in every state and Puerto Rico, the NIST Manufacturing Extension Partnership is uniquely suited to help American small manufacturers thrive in an e-commerce world. Each center works directly with small manufacturers to provide expertise and services tailored to their most critical business, technology, and training needs. Many MEP client companies report astounding improvements in productivity and profits through MEP assistance.

Recognizing the growing importance of information technology throughout the economy, MEP has stepped up its information technology assistance to small manufacturers. Throughout 1999, MEP centers helped small manufacturers successfully deal with Y2K problems through workshops across the country. Y2K self-help kits, a help center provided on-on-one assistance, and 24-hour-a-day assistance was provided through a web site. Building on this base of information technology support, MEP is training center field staff in e-commerce and Internet technologies so they can provide hands-on help to small manufacturers in adopting e-business practices. Beginning in the fall, MEP centers will offer seminars to help small manufacturers understand the promises and challenges of e-commerce and make informed technology and business decisions.

Supporting Research for Future E-Commerce Advances: The Advanced Technology Program

NIST's third major tool for advancing e-commerce is co-funding of private sector research to help develop the new technologies that enable future advances in the e-commerce infrastructure and new ways of exploiting e-commerce and information technology.

The Advanced Technology Program (ATP) bridges the gap between the research lab and the marketplace by providing cost-shared funding in the critical early stages of R&D. That is, when research risks are too high for other sources of funding, but technical success would bring about broad-based benefits. In a March 1998 workshop called "Defining the Advanced Technology Challenges of the Electronic Commerce Marketplace," industry strongly called for increased ATP investment in key technologies and infrastructure research that would enable e-commerce advances.

Industry makes numerous strong proposals to ATP for information technology work that supports e-commerce advances, and ATP has invested in a broad range of infrastructural technologies including: component-based software, learning systems, telecommunications, digital video and data storage, internet-based manufacturing, and telemedicine.

For example, ATP support enabled VitalWorks, a small Massachusetts company, to create a new software system that makes record keeping much easier for physicians. With the new system, the physician enters only a few key words in response to questions from the computer and the software creates complete, accurate clinical notes, while also entering all the diagnostic and treatment information into a database that can be used for research, tracking treatment effectiveness, and other applications.

This technology is now being used in electronic patient charts and has reduced errors of omission from as much as 60 percent to as few as 1 percent in some cases. A new software module is already used at some 300 U.S. sites by an estimated 5,000 doctors and it is predicted that the Veterans Administration could realize annual savings of several million dollars for each medical region. The underlying technology also could have applications in fields such as law and business.

FY2001 Ecommerce/Ebusiness initiatives

Although NIST is making valuable contributions to industry's evolution to e-businesses, it is clear that this is just the beginning, and there is much more work to be done. That is why NIST has proposed an FY 2001 e-commerce initiative with three components: MEP E-commerce outreach (+\$9M, \$15M total including \$6M reprogramming), Manufacturing Interoperability (+\$4M), and Wireless Technologies (+\$1M).

MEP E-commerce Outreach: NIST MEP's efforts to date are just a small step towards helping small firms acquire the resources and expertise needed to adopt e-commerce business practices. NIST's FY2001 budget request includes a \$9 million initiative to enable NIST MEP to work with the Small Business Administration and the U.S. Department of Agriculture on an e-commerce outreach program. This initiative will provide continued funding for approximately 200 information technology professionals who were added by MEP centers to work on Y2K outreach. It will also enable NIST MEP to develop tools to help small firms not only better understand e-commerce but to develop and implement an e-business strategy and use e-commerce technology.

Manufacturing Interoperability: This initiative will focus on working with industry to develop the measurements and standards necessary to ensure accurate and efficient exchange of manufacturing supply chain electronic data (+\$4M). Imperfect interoperability—barriers to communicating electronic data between manufacturers, in supply chains, and within enterprises—imposes a cost of at least \$1 billion per year on the automotive supply chain alone. In one recent case an engineering service provider was barred from bidding on an automotive manufacturer's projects during the two months it took to track down the source of a data translation error. It turned out not to have been the fault of the engineering service provider. Data exchange problems can cost large companies significant revenue from being late to market, or manufacturing defective products, but small companies might not be able to survive if they are barred from bidding on contracts for significant periods of time.

By 2003, it is estimated that 137 million business users will be involved in remote work of some kind.¹ Industry sources indicate that Fortune 500 companies already outsource 78 percent of their transportation, 54 percent of their distribution, and 46 percent of their manufacturing.² These numbers are expected to increase, with the third-party logistics industry expected to double to \$50 billion in the next two years.²

Without the improved measurements and standards that this initiative would develop, the increased volume of remote work, and outsourcing will result in increased costs to U.S. manufacturers.

Wireless Technologies: This initiative will focus on development of measurements and standards to enable broad adoption of next generation wireless communications (+\$1M). These wireless technologies will impact communications, commerce, and government. They will also result in new paradigms for health care, public safety, education, law enforcement, manufacturing, and entertainment. But without proper measurement tools and standards, the new wireless technologies will develop more slowly and inefficiently, impeding U.S. economic and technology growth and risking increased loss of market share and technology leadership to other nations in the highly competitive global marketplace. If we need any evidence we need look no farther than the experience with cell phones in Europe.

New measurement capabilities and standards are needed to enable U.S. industry to lead the transition of information technologies from desktop personal computers to a new paradigm of ubiquitous, networked and embedded computing connected by wireless links. This initiative will enable NIST to develop the measurements and standards infrastructure to support the emergence of new wireless information technologies

NIST has a very successful record of working for almost 100 years with industry, other government agencies, universities, and non-profit organizations to help provide the infrastructure for commerce and economic growth. The technologies of 100 years ago were very different than today's technologies, but the core nature of NIST's role remains the same: work with the private sector to develop and apply the measurements, standards, and technologies that enable prosperity and enhance quality of life. NIST is

already helping industry develop and apply e-commerce technologies that are transforming our economy. And we are prepared to take an even greater role in the future to help industry master the challenges and opportunities of e-commerce.

Thank you for this opportunity to appear before you today. I would be happy to take any questions.

¹ Key Issues in Mobile and Remote Middleware, K. Scherberger, Gartner Group (April 24, 1998).

² Internet Collaboration Gets Another Tool, Technical Insights Alert, John Wiley & Sons (June 11, 1999).

³ Ibid.

**Statement of
Raymond G. Kammer
Director**

**National Institute of Standards and Technology
Technology Administration
Department of Commerce**

Before the

**House Committee on Science
Subcommittee on Technology**

September 13, 2000

“The Role of Standards in Today’s Society and in the Future”

Madam Chairwoman and members of the Subcommittee, I am pleased to testify before you today on a subject of great importance to the United States. For the first time, government, industry, standards developers, and other interested parties have come together under the banner of the American National Standards Institute (ANSI) to develop a National Standards Strategy. Thank you for focusing national attention on this important advance for the United States.

Although most people do not realize it, standards and the methods used to assess conformity to standards are absolutely critical. They are essential components of our nation’s technology infrastructure—vital to industry and commerce, crucial to the health and safety of Americans, and basic to the nation’s economic performance.

A few figures illustrate the international significance and relevance of standards:

- About 80 percent of global merchandise trade is affected by standards and by regulations that embody standards.
- In terms of the U.S.-European economic relationship, standards influence an estimated \$200 billion in transatlantic trade.

For these and other important economic and social reasons, Commerce Secretary Mineta and I are delighted that the United States now has a new and very constructive National Standards Strategy. The Strategy builds on the strengths of the U.S.-based sectoral approach to standards development. It lays out the principles necessary for the development of national or international standards to meet societal and market needs and outlines a strategic vision for implementing these principles nationally and internationally. It also lays out a set of strategic initiatives with broad applicability, with roles for ANSI, standards developers, industry and government, to be applied according to their relevance and importance to particular sectors. I will touch on some of these initiatives in the context of what government agencies can contribute in more detail later.

The Department of Commerce and, in particular, the National Institute of Standards and Technology (NIST) are eager to assist the private sector in putting the National Standards Strategy into action.

Effective implementation of the strategy will help to ensure U.S. industry's success in the international marketplace in the years ahead. Because of the strong partnership that NIST has built with ANSI over the years, we believe we are well positioned to be a strong partner in this effort.

I should also point out, Chairwoman Morella, that you and your subcommittee have made important contributions that are embedded into the new strategy. Legislation that you championed—the National Technology Transfer and Advancement Act—is central to achieving key objectives of the strategy. The act also enabled NIST to help facilitate the strategy's development—a role that I will mention later.

Standards: Details of "Mega" Importance

The topic of standards and the challenge of effective standards development can bewilder, immersing the uninitiated in a blizzard of details. To some degree, this is unavoidable. After all, standards are details. They specify characteristics or performance levels of products, processes, services, or systems. Examples range from specifications for film speed or the arrangement of all the characters of the world's languages for computer processing to process standards for boilers and pressure vessels to the relatively well-known ISO 9000 standards for quality management systems.

Sometimes numbering hundreds or thousands of pages, these specifications can be details of great importance, of market-making significance. On the bright side, consider, for example, the Internet and e-commerce applications, where U.S. technologies are setting the standards for the rest of the world. On the dark side, consider the much more rapid diffusion of digital wireless phone and mobile-commerce—or m-commerce—applications in Europe and Japan. The market for m-commerce technology is in its very early stages. But a recent study estimates that Europe's mobile phone systems are 18 to 22 months ahead of ours. It attributes Europe's fast start, at least in part, to the adoption of common standards.

The process by which thousands upon thousands of standards are produced is invisible to most consumers. In the United States, standards are developed through a complex but effective system administered by the private sector, with participation by industry, academia, consumers, and government. The system has evolved over the last 100 years to meet the needs of U.S. industry and society in general. Rooted in the private sector, it has successfully met domestic marketplace needs on a sector-by-sector basis. The system benefits from strong industry support and participation at all levels in the process. Government, through its technical experts, also participates—as an equal, not as an overseer.

The result is a diverse, flexible, and inclusive system that has successfully met market needs and government regulatory and procurement needs. The global infrastructure needs this type of stakeholder support and involvement.

Over the years, the diverse U.S. standards community has developed rules for consensus, transparency, openness, balance, and due process—important parameters that have been presented to the World Trade Organization as bedrock principles for developing good and fair standards. Yet, this open, competitive system for developing standards creates major issues for us in the global market. Today, there are about 400 formal U.S. standards developers, and some 150 consortia, developing standards. ANSI is responsible for coordinating the formal U.S. system and serves as a point of contact for both the private and public sectors. Developing strategic policy positions and bridging sometimes competing positions can be difficult. Financing adequate U.S. representation in international activities can be another major difficulty and is often a point of contention.

Problems and challenges stemming from this situation can become vulnerabilities in global markets. Standards are becoming increasingly important due to several intensifying trends:

- the pace of technological innovation is quickening;
- trade volumes are growing faster than national economies; and

- business operations are globally distributed.

There is extreme pressure for the standards community to reckon fully with the realities of the brutally competitive, extremely fast-paced global economy. This is because standards are necessary complements of modern products, processes, and services. Standards can:

- promote industrial and market efficiency;
- foster international trade;
- lower barriers to market entry;
- diffuse new technologies; and
- protect human health and the environment.

But these benefits are not always achieved. In fact, the consequences of standards can be negative. For example, companies—and *nations*—can use standards to disadvantage competitors. Embodied in national regulations, standards can be crafted to impede export access, sometimes necessitating excessive testing and even redesigns of products. A 1999 survey by the National Association of Manufacturers reported that about half of U.S. small manufacturers find international standards or product certification requirements to be barriers to trade. And according to the Transatlantic Business Dialogue, differing requirements add more than 10% to the cost of car design and development.

With new markets opening up around the world—and with U.S. companies facing stiff competition even in our domestic market—standards that are barriers to trade take on monumental importance. Unfortunately, we hear more and more about instances in which American firms are finding the gates to trade closed as compliance with standards developed elsewhere becomes the price of admission.

Evolution of the Strategy

The United States has long needed a compelling, national standards strategy if we are to realize the intended benefits of standardization and compete effectively in global markets. While there has been much talk by the U.S. standards community about the need for such a strategy, it is only within the last two years that the community has come together to address this challenge. I am pleased to be here with ANSI to unveil the National Standards Strategy.

Over the past two years, NIST and ANSI have undertaken a number of steps to foster development of this new strategy. At a March 1998 ANSI Board of Directors meeting, I challenged the ANSI community to come together to develop a national strategic approach to standards. This suggestion was followed by a series of meetings with industry, with standards developing organizations, and with government agencies – all designed to gather input and elicit ideas for strategic approaches.

NIST and ANSI then co-hosted a Standards Summit in September 1998. More than 300 participants—from all sectors and stakeholder groups—weighed the merits of pursuing a national standards strategy. There was a strong sentiment that overall, users and developers of standards need to advance U.S. interests more consistently and more effectively at both the national and the international levels.

NIST produced several white papers on issues that had arisen at the Summit and shared these widely. Even more importantly, under the ANSI umbrella, NIST and ASTM International co-sponsored two facilitated workshops to define the needs to be addressed by the national standards strategy. Throughout, the process has been inclusive. Government agencies, industry, standards developers, and consumers, have been full participants.

Our trading partners are addressing similar issues. Europe has had a standards strategy in place for some time and it is running at full throttle. It is fair to say that European governments and industries believe that they can meet domestic needs and also create a competitive advantage in world markets by strongly influencing the content of international standards. There is already a direct relationship between the International Organization for Standardization (ISO) and the International Electrotechnical Commission

(IEC) and their counterpart European regional standards organizations – CEN and CENELEC – under which European regional standards can be processed in parallel as ISO or IEC standards. Similarly, our neighbors to the North, Canada, unveiled their strategy earlier this year. A major goal of the Canadian strategy is to influence the formation and evolution of global standards that are important to Canada. Interestingly, the Canadian standards strategy recognizes both the major formal international venues for international standards development—ISO and IEC—and also notes the importance of monitoring and influencing international standards development centered here in the United States.

Now the United States has joined our key trading partners in launching a standards strategy to guide collective responses to domestic and international standards issues. The strategy will help the decentralized U.S. standards community to face more squarely the issue of developing and adopting international standards. While many standards developed by U.S. organizations are used internationally, worldwide pressure is increasing to move toward standards developed and promulgated globally. Industries in all countries, including the United States, want standards that enable companies to build products that are accepted worldwide.

Shared goals and principles embodied in the National Standards Strategy provide motivation and direction. They establish a basis for collective action so that members of the U.S. standards community will work cooperatively to develop sound policies in support of global trade. Our mutual goals oblige us to work proactively with our trading partners to further shared technical interests. And they commit us to participating regularly in the critical activities of technical committees.

We anticipate that, through vigilance and sustained commitment, U.S. industry can greatly increase the likelihood that U.S. technical input is reflected in global standards. This will translate into fewer technical barriers to market entry for U.S. exports, which should benefit the entire national economy.

The strategy recognizes that standards needs are diverse and that these needs cannot be addressed by a monolithic, top-down system of standardization. We have agreed to pursue sectoral approaches where one size does not fit all. The strategy fully recognizes the importance of serving industry needs, while ensuring continued strong commitment to health, safety and protection of the environment.

Standards in the IT Sector – Is a National Strategy Relevant?

A sectoral approach recognizes that there is no simple recipe that can be handed down to fit all needs. The National Standards Strategy provides guidance, coherence and inspiration to those inside and outside the system without constraining creativity or effectiveness. Thus it is flexible enough to remain relevant to diverse sectors – from construction equipment to wireless Internet and other e-commerce technologies.

New technologies for wireless Internet will have major economic ramifications, in the United States and globally. Important standards development work is taking place in a variety of venues – both traditional and nontraditional. Consortia, such as the World Wide Web Consortium, and forums (e.g. Wireless Access Protocol Forum and others) are important venues that are outside the formal standards development system. The National Standards Strategy specifically recognizes that successful standards processes are flexible, allowing the use of different methodologies to meet the needs of different technology and product sectors. As consortia and forums develop their specifications, their work becomes the basis for action by the formal process when that adds value.

There is at least one area where the more formal standards development process, with its principles of openness, transparency, balance and consensus, can make a contribution to the spread of e-commerce technologies. The success of these new technologies is closely linked to the development of interoperability standards, which specify how devices communicate with each other. Successful standardization efforts in this area are global and driven by technical superiority.

Standardization of wireless Internet technologies on the cellular telephone model (third generation wireless, for example) has taken place under the auspices of the International Telecommunications Union (ITU), the traditional body for the publication of international telecommunications standards.

The ITU is a United Nations agency with national governments as member organizations and strong private sector participation in developing standards. The United States has a significant presence in ITU standards development activities. A great deal of standardization activity related to wireless technologies based on computer network technology has been centered in the Institute of Electrical and Electronics Engineers (IEEE), a nonprofit technical professional society of 350,000 members with close ties to ISO and IEC's Joint Technical Committee 1 on Information Technology.

Standardization of infrastructure is important, even for wireless Internet and e-commerce technologies. NIST is making a major contribution to the successful development and deployment of these technologies by accelerating the process of voluntary industry standardization and keeping it solidly focused on technical issues. The principles embodied in the National Standards Strategy provide important guidance for ensuring that these standardization efforts are recognized globally.

Implementing the National Standards Strategy – Government Role

Crafting a National Standards Strategy acceptable to all stakeholders is a significant achievement. Now we must carry this momentum forward and successfully implement the strategy. Government agencies, including NIST, have key roles to play. Indeed, the strategy underscores the importance of an effective public-private partnership. For government, there is much to be gained.

For the next few moments, I will highlight several critical areas where, I believe, government action can have a significant impact and move the strategy forward.

For many years, government agencies have been directed by Executive Branch policy to participate in the development of voluntary consensus standards and to use these standards in regulatory, procurement and other policy activities. More recently, the National Technology Transfer and Advancement Act of 1995, which originated in this Subcommittee, assigned NIST responsibility to coordinate federal, state, and local standards and conformity-assessment activities with those of the private sector.

At the federal level, the Interagency Committee on Standards Policy (ICSP), chaired by NIST, leads this shift to greater reliance on voluntary standards. As NIST reported earlier this year, federal agencies are already increasing their use of voluntary standards; they are withdrawing competing federal standards; and they are refraining from developing agency-unique standards. The National Standards Strategy provides important guidance for the ICSP. We anticipate that it will shape future agency activities in this area, both domestically and in government-to-government activities at the bilateral, multinational, and global levels.

At the same time, NIST and the rest of the ICSP must act to reverse the decline in federal participation in voluntary standards activities. Agencies that use voluntary standards for regulatory or procurement purposes should contribute expertise and resources to the development and implementation of these standards.

The ICSP, which is charged with implementing both the law and executive branch policy, has welcomed the issuance of the National Standards Strategy. The ICSP recognizes the strategy as a positive step forward, addressing many issues of concern to government and other stakeholders of the standards community. The ICSP has encouraged its members to examine the strategy and to implement it as appropriate for each agency. With this start, appropriate elements of the strategy should filter through individual agencies and help to guide standards-related activities. For example, federal agencies can do a better job of leveraging their relationships with state and local governments to encourage greater use of voluntary consensus standards. This, in turn, would help to reduce regulatory redundancy and duplicative testing requirements.

Some of the tools for this type of streamlining already are in place. For example, NIST recently issued guidance on conformity assessment to federal agencies. This document advocates intergovernmental efforts at all levels to remove unnecessary testing and certification requirements, which would improve the efficiency and transparency of domestic and export markets. Also, in July of this year NIST signed a Memorandum of Understanding (MOU) with the National Cooperation for Laboratory Accreditation (NACLA). The MOU commits NIST to encourage agencies at all levels to accept the use of laboratory

accreditation bodies recognized by NACLA, and to encourage U.S. accreditors to seek NACLA recognition. For its part, NACLA commits to follow accepted international guides and standards and to accommodate relevant government requirements in the implementation of its recognition program.

Principles outlined in the National Standards Strategy closely match regulatory and procurement initiatives already under way in many agencies. But the strategy can help agencies identify additional opportunities for improvement. For example, the strategy underscores the importance of consumer participation in standards activities—consistent with the core principles of consensus, openness, balance, and transparency. In response and where appropriate, agencies may wish to initiate standards information and participation programs for consumer-focused activities.

NIST Role

In addition to working with other government agencies to encourage implementation of relevant portions of the National Standards Strategy, there is a great deal that NIST itself can do to support ANSI's efforts to implement the strategy. We have a very good working relationship with ANSI already. This is reflected both in our Memorandum of Understanding (MOU) and in the broad range of joint activities we have already undertaken. The MOU formalized our mutual agreement on the need for a unified national approach to develop the best possible national and international standards. It also affirmed our organizations' shared commitment to enhance and strengthen the U.S. national voluntary consensus standards system. We will revise and extend the MOU to reflect the goals of the National Standards Strategy.

NIST also will incorporate National Standards Strategy principles into our own standards strategy. One of my five major organizational goals is for NIST to provide technical leadership for the nation's measurement and standards infrastructure. This includes fostering and technically assisting the development of high-quality standards needed by government and industry. This goal also includes cooperating with ANSI to improve the effectiveness and responsiveness of the national system for developing voluntary standards. Another element is increasing our work with international bodies to ensure that U.S. standards are understood and accepted by our trading partners.

NIST can make a very significant contribution by endorsing the ANSI process for accrediting standards development organizations, which often are referred to as SDOs. NIST endorsement would establish that American National Standards (ANS) meet federal criteria for voluntary consensus standards. Through its process, ANSI ensures that its guiding principles—consensus, due process and openness—are followed by the more than 266 SDOs it has accredited. ANSI-accredited standards developers are committed to supporting development of national and, in many cases, international standards. And they are responsive to critical technology, market, and regulatory trends, which also concern federal regulators. NIST endorsement of the ANSI accreditation process would go well beyond our current MOU, but we intend to evaluate this option for encouraging greater federal use of voluntary standards.

U.S. Participation in International Standards Activities

A major focus of the National Standards Strategy is on increasing U.S. presence and leverage in international standards activities, and working to improve processes internationally to more closely reflect U.S. principles and vision. ANSI represents the United States in international standards-development activities in ISO and IEC, as well as in private sector regional bodies in the Americas and Asia-Pacific. The Administration supports full industry and government participation in ANSI's international activities, to ensure that U.S. interests are fully represented in ISO and IEC.

Without this participation, the U.S. voice will not be heard and U.S. technical positions will not be promoted in ISO, IEC and other international standards development organizations. This can exclude U.S. exports from markets where these standards are adopted as product testing standards, government regulatory or procurement requirements, or as reference methods in testing protocols. Recent communications from the management of ISO, IEC and ITU to the World Trade Organization (WTO) propose that only those international organizations that operate according to certain principles, including limiting membership to appropriate national bodies, should be recognized by the WTO as International

Standardizing Bodies. While the U.S. government strongly opposes such special status, the Europeans would be happy to see this happen and would like to see the links between ISO and IEC and European regional standards organizations (CEN and CENELEC) become even closer so that European standards can move even more easily into ISO and IEC. Certainly, these close links ought to be re-evaluated to the extent that they disadvantage other regions of the world and exclude their technologies and philosophies.

ANSI will be presenting the U.S. National Standards Strategy at the upcoming ISO General Assembly and IEC general meeting in September 2000. As part of this process, I have recommended to ANSI that we seek direct ISO and IEC recognition of the U.S. sector-based approach to standards development. In some sectors, U.S. standards, developed with extensive international participation, represent a body of work that complements existing ISO and IEC work, without overlapping. Over the past year or so, ANSI and U.S. SDOs have been working with ISO on a series of pilot projects, testing various approaches to bridging U.S. standards into the ISO arena. We could build on these pilot projects to move U.S. standards more rapidly into the formal international arena. More generally, we in government also can advance strategic goals and facilitate improvements in how other nations develop and apply voluntary, consensus standards. Federal agencies interact with their foreign counterparts in many venues. Examples are treaty organizations, trade negotiations, joint commercial commissions, training, and business development committees. In these encounters, U.S. representatives can improve our trading partners' understanding of the U.S. approach to standards development and use, and build the strategic alliances desperately needed in the global marketplace of the future.

Conclusion

As the National Standards Strategy indicates, the challenge for the United States in the 21st century is to turn its capabilities and achievements toward greater leadership in developing the standards and operational structures needed by the global market. Meeting this challenge requires coordinated policy development among U.S. industry, U.S. government agencies, and U.S. voluntary standards bodies. It requires developing strategic alliances with our counterparts around the world to develop standards that reflect Asian, European, Latin American, African and North American interests. Thus, an effective global strategy would be one that works to ensure fairness at the international level. The playing field must be level so that one region does not dominate over others; so that developing nations have the opportunity to participate; and so that industry needs are met while protecting health, safety, and the environment.

The formal international process must provide a voice for all interested and affected parties, and allow acceptance of standards based on merit, not simply political decision-making. The standards infrastructure of the 21st century would be greatly strengthened if it contained the flexibility, diversity, and ability to meet user needs contained in the U.S. approach. The United States has an incredible opportunity to work with the international community to incorporate sound U.S. principles into the standards used worldwide. The National Standards Strategy allows us to move easily to these next steps, including working to level the international playing field, as well as secure the high-level industry backing that the standards community needs.

Clearly, if we are to succeed and prosper, U.S. industry, standards developers, and government must continue to cooperate with each other in standards and conformity assessment activities. ANSI, NIST, and the standards community must - and will - continue to work together to develop and implement unified U.S. positions on technical and standards policy issues at the domestic and international levels. If we continue to progress together, as we have over the last several years, the future will be bright. Achieving this bright future, however, means effective implementation of the National Standards Strategy. NIST is committed to continue to work aggressively with ANSI and its members, including other federal agencies, to build on the great beginning we have made in developing a sound and effective National Standards Strategy. A first step is to raise national awareness of the importance of the strategy for our economy. Again, I thank this Subcommittee for spotlighting this achievement.