Norman J. Latker
Federal Technology Management Policy Division
U. S. Department of Commerce

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It is clear that we are in the midst of a major economic transition triggered by foreign competition which is requiring older capital-intensive industries to make significant economic adjustments.

Part of the transition is explained by the fact that we are experiencing a worldwide explosion in new technologies. Microelectronics, biogenetics, robotics, new materials, information sciences, and other new technologies are the foundation of future economic growth. These new technologies will make some of our major capital investments uneconomic before the end of their planned lives. In steel, open-hearth furnaces can no longer compete with basic oxygen furnace technology, or the potential of new Swedish plasma technology. And in just a few years, we can expect graphite fiber reinforced plastics that are stronger than steel and lighter than aluminum to significantly compete for our metal markets.

However, depending on how we react as a nation, the total impact can be positive. The delivery of new American inventions, no matter where created, to the marketplace can create an array of new businesses, and new businesses mean new jobs.

Our economic recovery and long-term economic well-being heavily depend upon start-up of new high-technology industries. American leadership in world technology is in the balance. Huge trade deficits are an indication that foreign invention is taking an increasing part of markets previously dominated by United States goods. The balance is tilting away from our leadership in steel, automobiles, machine tools, and consumer electronics.

Part of the reason for this erosion is that other nations are rapidly expanding their technological activities. Ten years ago the United States, with five percent of the world's population, generated about 70 percent of the world's technology. Currently, we generate about 50 percent of it, and by 1990 we may only be contributing 30 percent, despite the fact that America will be doing more and more R&D every year.

Rather than accepting exit from some industries or raising trade barriers, there are better options -- we can remove barriers and disincentives to the delivery of new U. S. products and processes to the marketplace. Meeting foreign competition this way makes far more sense than isolating ourselves and allocating resources inefficiently through protectionism.

The U. S. invests 110 billion dollars annually in research and development. Fifty-five billion of this is federally-funded and the remaining 55 billion funded by the private sector. By performer the federally-funded 55 billion is distributed as follows:

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| 1. | Small businesses - | approximately | 1 1/2 billion |
| 2. | Larger businesses - | " | 21 1/2 billion |
| 3. | Universities + other nonprofits (including Government-Owned-Company Operated (GOCO) Laboratories) | " | 10 billion |
| 4. | Government-Owned-Government Operated Laboratories | " | 15 billion |

A number of figures indicate that we are not getting the kind of result one might expect from an investment of this magnitude. For example, 110,000 patent applications are filed in the U. S. Patent and Trademark Office annually. Of these 110,000 applications only 3,000 can be identified as emerging from government sponsored research. The remainder are the result of private sector R&D - including those coming from foreign sources. In addition, of the approximately 28,000 U. S. owned patents only a fraction suggested to be between one percent to five percent have been licensed. Statistics like these, numerous critical studies on the lack of usable results, and increased foreign competition have combined to prompt the Administration to increase the rate of U. S. commercialization of new products and processes created by the 55 billion federal investment in R&D. This has been intensified recently by the growing belief that the federal investment is actually feeding foreign competition through the publish or perish culture which prevails at university and federal laboratories. We even make collection of this information easier for foreign shoppers through centralized dissemination services at NTIS, NASA, and DOE. Japan is well known to be one of NTIS' best customers.

Commerce has approached the task of increasing the commercialization of government funded technology by identifying the major theoretical principles that need to be observed in order to create the best environment for success. Here are what we believe they are:

The First Principle - The creating or inventing organization must be permitted to manage its technology in a manner similar to an organization creating technology with private funding subject only to the government right to use for its own needs. Note that it is this principle that has been most ignored by past and continuing government practices. These practices in most part separate management or ownership of technology from the creating organizations and put it in the hands of others who do not have first hand knowledge of the technology and, therefore, the ability to place a value on it. We believe that once separation occurs the likelihood of continuing the iterative development process that is necessary to successfully deliver technology to the marketplace is not possible. Further, the most likely champion or advocate of the technology is lost.

The Second Principle - Management of technology by the inventing or creating organization must include the ability to evaluate each new technology and determine whether it should be published only, patented, copyrighted, maintained as confidential information, possibly trademarked or some combination of these actions. In a free market economy intellectual property rights must be established and sometimes licensed away to justify the investment of private risk funding in some technologies, for

example, pharmaceuticals and other life science technologies. Failure to establish such rights in a potential marketable product by the creating organization could preclude private sector involvement in completing development to the marketplace. While this principle may seem simple and obvious to this sophisticated audience, it is presently not applied in most federal laboratories and is just beginning to be understood by universities.

The Third Principle - The creating organization must have the incentive to take on the management responsibilities of principles 1 and 2. In profit-making performers ownership of the technology may permit exclusion of competition from the marketplace for limited periods, thereby maximizing profits. But in the case of other performers such as universities or federal laboratories the major incentive would be the return the organization receives in bartering or licensing the rights it created under the second principle. Of course, that return could be in the form of royalties on a successfully marketed product or cost-sharing of a research project that could even result in failure, and

The Fourth Principle - Because the culture of most publicly funded organizations (other than profit makers) is publish or perish there must be an incentive for creative investigators in these organizations to concurrently recognize the need in some instances to also patent, copyright or maintain technology in confidence. In Public Law 96-517 this was accomplished by guaranteeing the inventor a share of the royalties received by

his university. This principle was not extended to the small businesses covered by P. L. 96-517 since they are not driven by the publish or perish culture. Let me add that this principle is in keeping with John Locke's belief that "man has a right to what he hath mixed his labours with." Since inventions made by nonprofit and government laboratories are in most part serendipitous and their commercialization outside assigned duties, royalty-sharing as an incentive to pursue commercialization makes good sense at those laboratories.

These are the theoretical principles that we believe need to be provided to achieve optimum commercialization of federally-funded research. But where are we in pactice?

In 1980, the first piece of this puzzlement went into place. Public Law 96-517 - the Bayh-Dole Act - gave universities and small businesses the right to ownership to all patentable technology resulting from federal support. The Administration's support and implementation of P. L. 96-517 through OMB Circular A-124 has stimulated an explosion of private sector investment in commercializing university technology which many of you are aware. The Act is congruent with the four principles discussed except that the performers are limited to electing patent ownership. The ability to copyright and maintain ideas in confidence is left to individual agency discretion on a contract-to-contract basis. Other than this the Act clearly implements the decentralization and incentive concepts of the four principles.

In 1982, in a less well-known Act Public Law 97-219 - The Small Business Innovation Research Program Act, 1 1/4 percent of government research funding was set aside to fund innovative proposals from small businesses. One part of the Act required that agencies permit small businesses funded by this program to retain ownership of all technical data either generated or delivered in performance of the award. This provision coupled with P. L. 96-517 results in small businesses funded under the set-aside to elect not only to patent the results of its research but to establish copyright protection and maintain it as confidential. The SBIR program is the only present agency-wide program in which all four principles are completely addressed.

In 1983, President Reagan required all federal agencies, to the extent permitted by law, to treat all businesses in the same manner that small businesses and universities are treated under P. L. 96-517. NASA's Space Act and DOE's Nonnuclear and Nuclear Acts, however, are being interpreted by these agencies as permitting this only on a contract-by-contract basis with a result that most contracts in these agencies reserve the right of ownership to inventions in the government. The President's Statement was also limited as was P. L. 96-517, to election of patent ownership. The ability to copyright or maintain ideas in confidence was left to agency discretion. Notwithstanding, the President's Statement administratively expands the four principles as limited above to a very large element of government funded performers.

In 1984, P. L. 98-620 amended P. L. 96-517 in a number of ways most of which were intended to eliminate conditions on university and small business ownership of patentable technology, which were considered unnecessary based on the experience under the Act. However, one of the more important elements of the Act was elimination of the exception which permitted agencies the right to retain ownership of patentable technology generated at government owned-university operated laboratories. This in most part was aimed at permitting DOE owned university run laboratories to manage their own technology. These laboratories are funded at the rate of between one and two billion annually. The Act also reassigned the drafting of regulations to implement P. L. 96-517 from OMB to the Department of Commerce. ~~The Department is in the final stages of~~ issuing regulations which will replace OMB Circular A-124 and include the DOE laboratories discussed within the four principles.

The Department is involved in current efforts to develop a government-wide policy on rights to technical data either developed or delivered in performance of government supported research. The Department believes that the government's interest in technical data could be protected as patentable rights are under the new patent policy by negotiating the rights agencies need to perform their mission at the time of contracting.

Contractor ownership of technical data (subject to appropriate license rights in the agency) could serve at least the following purposes:

a. It would place control of the data in the hands of U. S. companies to the exclusion of foreign competition. Clearly this is a better choice than permitting foreign competition the access they have under present policy.

b. It could dampen the flow of sensitive but unclassified data to the extent it had an identifiable commercial potential.

Public Law 97-219 which establishes a Small Business Innovation Research program (SBIR) in all agencies having research programs over a designated amount provides for just such ownership in small businesses functioning under this Act. Discussions are in progress to extend this concept to other contract performers.

Finally, we are looking forward to the extension of the four principles to the last major group of performers - the government owned-government operated laboratories.

Senate Bill (H. R. 3773) is aimed specifically at permitting federal laboratories to enter into cooperative research and development arrangements within their mission assignment with the private sector. Under these arrangements the laboratory may:

1) accept funds, services and property from collaborating parties and provide services and use of facilities in exchange

2) grant or agree to grant in advance to a collaborating party patent licenses or assignments, or options thereto, in any invention made by the laboratory

3) accept royalty-payments for laboratory use including sharing with laboratory inventors

It is clear that foreign competition has focused our attention on the need to expedite new inventions through the innovation process.

The innovation process is rarely, if ever, controlled in its entirety by a single organization. Clearly the government is involved at many points through various regulatory controls as well as funding contract research. Nonprofit organizations and federal laboratories to the extent they invent are involved. Venture capitalists, banks, technology management organizations and many others are involved. It is axiomatic that if the process is to work efficiently, all those involved must assume what we call a win--win attitude. We must continue to foster an attitude of government, industry, nonprofit cooperation and the willingness to abandon adversial attitudes which frustrate the innovation process and undermine our ability to compete.