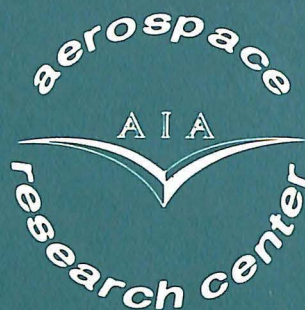




THE NATIONAL TECHNOLOGY PROGRAM

Utilization of Industry

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Utilization of Industry

**A Publication of
AEROSPACE RESEARCH CENTER**

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The mission of the Aerospace Research Center is to engage in research, analyses and advanced studies designed to bring perspective to the issues, problems and policies which affect the industry and, due to its broad involvement in our society, affect the nation itself. The objectives of the Center's studies are to improve understanding of complex subject matter, to contribute to the search for more effective government-industry relationships and to expand knowledge of aerospace capabilities that contribute to the social, technological and economic well being of the nation.

Contents

CHAPTER	PAGE
1 INTRODUCTION	5
THE CHANGING ENVIRONMENT	5
THE PROMISE	6
2 TECHNOLOGY: A NEW NATIONAL POLICY	7
SUMMARY OF THE PRESIDENT'S MESSAGE	7
Strengthening the Federal Role	7
Supporting R&D in the Private Sector	8
Applying Government-Sponsored Technologies	8
Improving the Climate for Innovation	8
Stronger Federal, State and Local Partnerships	8
World Partnership in Science and Technology	8
COMMENTARY AND ANALYSIS	8
SUMMARY	9
3 THE ECONOMIC POTENTIAL OF INDUSTRIAL TECHNOLOGY	11
INTERNATIONAL TRADE	11
PRODUCTIVITY AND ECONOMIC GROWTH	13
EMPLOYMENT	14
INCENTIVES FOR STIMULATING INDUSTRIAL TECHNOLOGY	15
R&D TAX INCENTIVES	15
A "NATIONAL TECHNOLOGY BANK"	15
ANTITRUST LAWS	16
SUMMARY AND RECOMMENDATIONS	16
4 BARRIERS TO THE UTILIZATION OF INDUSTRY ON MAJOR DOMESTIC PROBLEMS	17
GOVERNMENTAL RESPONSIBILITY	17
FEDERAL, STATE, AND LOCAL GOVERNMENTAL INTERACTION	18
BARRIERS TO MARKET AGGREGATION	18
SUMMARY AND RECOMMENDATIONS	20

CHAPTER	PAGE
5 FEDERAL PROCUREMENT POLICY INCENTIVES	21
INDUSTRY FUNDED RESEARCH AND DEVELOPMENT	21
COST SHARING	22
PATENTS	23
SUMMARY AND RECOMMENDATIONS	24
6 NATIONAL POLICIES	25
TECHNOLOGY	25
DOMESTIC PROBLEMS	26
ECONOMIC TRADE	26
INTERNATIONAL TRADE	26
GOVERNMENT PROCUREMENT	27
PERSPECTIVE	27

Graphs

1 U.S. Trade Balance Trends	12
2 Trade in Research-Intensive Products	13

CHAPTER

1 INTRODUCTION

For the first time in history, the President, on March 16, 1972, delivered a message to Congress on the burgeoning importance of science and technology to national progress. The President stressed that "... the impact of new technology can do much to enrich the quality of our lives. The forces which threaten that quality will be growing at a dramatic pace in the years ahead. One of the great questions of our time is whether our capacity to deal with these forces will grow at a similar rate. The answer to that question lies in our scientific and technological progress."

Based on the experience and insight of a major segment of the nation's high technology industry, this study endeavors to provide perspective on the importance and potential of the Presidential message and to analyze concepts for meaningful industry participation. The goal is a more effective utilization of industry in meeting the nation's technological challenges.

THE CHANGING ENVIRONMENT

During the last quarter century, U.S. science and technology has experienced sustained growth from which the country has achieved much of its economic and social vigor. While this growth also has had side effects, it has brought this country an unprecedented range of options and potentials for satisfying human aspirations.

In the midst of the material abundance generated by the unparalleled technological achievements, the nation is troubled by problems related to society and the quality of life. There is increasing concern with urban degradation and crime, geographic and ethnic pockets of poverty, inequality in education, inadequate health care systems and housing, and growing drug abuse. There also are problems generated as side effects by the rapid growth of technology, among them water and air pollution, ineffective solid waste disposal and traffic congestion.

At the same time, the world economy also has

been changing, and the U.S. no longer is the unchallenged leader in international trade and technological sophistication, or the primary source of the world's productive capacity. Foreign competition has become so capable and aggressive that our trade surplus has eroded from a \$7 billion level in the early 1960's to a \$2 billion deficit in 1971. Persistent unemployment, inflation and other factors all add to a growing concern over the nation's domestic economy and international trade.

With this has come a decline in public support for technology. Changes in funding levels for research and development provide the most direct indicator. During the ten-year period, 1958-1967, the investment in research and development doubled. Since that time outlays have been declining both as a percentage of Gross National Product (GNP) and as a percentage of the federal budget.

Even before the drop in funding support, a shift had begun in the relative share of R&D support

between government and industry. After 1966, the federal growth rate dropped sharply from nine percent per year to the current one percent, while the non-federal (primarily industrial) growth rate remained constant at about nine to ten percent.

The shift in the relative share of total R&D support between government and industry, and the markedly different growth rates have had significant impact on the type of R&D being emphasized. With the decline in the government's share in R&D funding, there has been a shift in the overall direction of national R&D, resulting in a reduction in basic research and highly advanced (and higher risk) projects, traditionally financed by the Federal Government.

Changing national priorities also have been reflected in reallocations of federal R&D expenditures. Substantial reductions in defense, space and nuclear energy programs have occurred—especially in applied R&D—which have not been offset by commensurate increases in other programs.

This shift in priorities and the reduced support for R&D has created serious unemployment among scientists and engineers. Perhaps of even greater concern is the threat to the nation's future scientific and technical manpower resources. Changes in federal activities or programs exert a significant influence on the market for graduates of various educational disciplines. Paralleling the decline in federal R&D expenditures has been the number of scientists and engineers graduated. Because of the long leadtime required for their education and training, future options for advancing technology in an increasingly competitive world will be limited.

THE PROMISE

The seriousness of the situation is receiving meaningful recognition. Several government studies have been made of national economic and social needs, and of the role of technology in their satisfaction. Among these are studies by the Office of Science and Technology; special studies by the Domestic Council to identify new areas amenable to technological opportunities; government consultations with industry (several hundred companies and trade associations), scientific, academic and other professional groups; and ongoing reviews of R&D-related issues by all major federal agencies, White House task groups, and the Congress.

As a result of these efforts, the President proposed strengthening the federal role in science and tech-

nology in both his 1972 State of the Union Message and his budget message for Fiscal Year 1973. He then presented to Congress his special message of March 16, 1972, in which he called for reharnessing "the discoveries of science in the service of man . . . an important element in our national progress. . . ." He outlined the problems of our domestic economy and the decline in our international economic position, and initiated the formulation of a national science and technology strategy, focused on civilian needs.

A major implementation of the President's message is the Federal Government's R&D and Technology Experimental Incentives Program. Its goal is to help stimulate technological innovations, to solve critical domestic problems, thus improving the competitive position of the United States in world trade and utilizing the skills of unemployed scientists and engineers. Commerce Secretary Peter G. Peterson underscored the importance of utilizing the nation's science and technology capability with this comment: "In a real sense, science and technology are being enlisted as important components of the new economic policies."

The key questions now are whether the capabilities of technology will achieve their promise, and how it will be mobilized. This study addresses these questions in the following chapters:

Chapter II summarizes the special Presidential message on science and technology and provides both commentary and analysis.

Chapter III discusses the three basic economic problems identified by the President—international trade, productivity, and employment—from the viewpoint of realizing the potential economic contributions of industrial technology. Several recommendations are made.

Chapter IV examines the very difficult subject of ways to better utilize industry in solving those national problems. Principal barriers are identified, as well as ways to reduce or eliminate them.

Chapter V provides three specific, major cases where excessive federal regulation is currently acting as a barrier to private innovation—a direct conflict with the intent of the Presidential message. Recommendations are made.

Chapter VI is presented in the form of an overview, summarizing the key points of the study and presenting broad policy recommendations. These are synthesized from the detailed recommendations in individual chapters.

CHAPTER

2 TECHNOLOGY: A NEW NATIONAL POLICY

The President's March 16, 1972 message to the Congress stated:

"... innovation is essential to improving our economic productivity ..." and "... the impact of new technology can do much to enrich the quality of our lives." Without question, both aspects are of vital importance to the future of the nation.

Greater productivity can help the United States expand its markets, thereby creating new and better jobs for millions of Americans. Better technological performance is essential not only to the health of the nation's domestic economy but to the country's ability to compete successfully in world markets.

The President cautioned, however, that the forces which threaten the quality of life are growing at a dramatic pace and stated that, "One of the great questions of our time is whether our capacity to deal with these forces will grow at a similar rate. The answer to that question lies in our scientific and technological progress."

Calling for a national commitment to be sure that "... our scientific and technological resources will be used as effectively as possible in meeting our priority national needs," the President set forth initial thoughts toward achieving a new sense of purpose and a new sense of partnership in technology. New partnerships are required, he said, to bring "... together the Federal Government, the private sector, the universities, the states and local communities in a cooperative pursuit of progress."

SUMMARY OF THE PRESIDENT'S MESSAGE

The Presidential statement is set forth in six specific sections; however, an analysis of the message

reveals that it actually contains three overall and important thrusts. First, it addresses actions for stimulating support for research and development and innovations in the private sector. Second, it articulates actions for strengthening collaboration between federal agencies and state and local governments. Third, the President identifies necessary actions for promoting cooperation between the U.S. and other nations in science and technology. Although these three major thrusts seem to prevail, the following summarizes the six elements as contained in the message.

Strengthening the Federal Role

The President firmly believes that the role of the government in shaping American technology is pivotal; thus he outlined the following specific points which are necessary actions on the part of federal leadership:

- Strengthen the overall technology base that underlies future national security;
- Increase significantly federal funding for research and development related to domestic problems in such areas as new energy sources, transportation, prevention of natural disasters, drugs and bio-medical research;
- Reorient the space program to focus on domestic needs, with the space shuttle development as an essential first step;
- Draw more directly on the capabilities of our high-technology agencies—Department of Defense, National Aeronautics and Space Administration, Atomic Energy Commission and National Bureau of Standards—in applying R&D to domestic problems;

- Improve the technological basis for setting federal standards and regulations;
- Increase R&D funding to universities and colleges; and,
- Authorize the National Science Foundation to support applied research in the scientific and technological community.

Supporting R&D in the Private Sector

Recognizing that, "The direction of private scientific and technological activities is determined in large measure by thousands of private decisions—and this should always be the case," the President stated that federal support of private research and development is necessary and desirable when (a) the market mechanism is not effective, or (b) when risks are excessive for individual companies but acceptable to society as a whole.

Applying Government-Sponsored Technologies

More effective application by the private sector of government-owned technology is to be sought by the National Science Foundation and the National Bureau of Standards. More active exclusive licensing to private firms and the obtaining of domestic and foreign patent protection of government technology was assigned to the President's Science Advisor and the Secretary of Commerce.

Improving the Climate for Innovation

The President noted that policies in such areas as tax, patent, procurement, regulation and antitrust can have a significant effect on the climate for innovation. In this regard, he directed the National Science Foundation to support a program with assessment and studies focused specifically on barriers to technological innovations and on the consequences of changing federal policies to reduce or eliminate the barriers. In addition, he:

- Proposed legislation to encourage the development of small high-technology firms;
- Named the National Science Foundation and the National Bureau of Standards to determine effective ways of stimulating non-federal investment in R&D and of improving the application of R&D results;
- Designated the Department of Commerce as a focal point within the Executive Branch for policies concerning industrial R&D;
- Established a new program for R&D prizes; and,

- Proposed national conversion to the metric system of measurement.

Stronger Federal, State and Local Partnership

New partnership arrangements between federal agencies and state and local governments are to be developed. The President's Science Advisor, in cooperation with the Office of Intergovernmental Relations, was designated as the focal point for federal agency discussions with representatives of state and local governments to examine ways: (a) to communicate priority needs of state and local governments to guide federal R&D planning; (b) to assure state and local government access to technical resources of major federal R&D centers concerned with domestic problems; and (c) to encourage aggregation of state and local markets to stimulate innovation and economies of scale.

In addition, the NSF and NBS will study techniques to stimulate the use of R&D by state and local governments; and how to strengthen the ties among governments of all levels, industry, and universities.

World Partnership in Science and Technology

The President directed the Department of State to coordinate activities of federal agencies in identifying new opportunities for international competition in R&D. Other countries are invited to join in U.S. research efforts in such areas as cancer research and adverse health effects of chemicals, drugs and pollutants. A broad review was initiated for determining how the U.S. could more effectively apply our solutions of domestic problems to foreign needs.

COMMENTARY AND ANALYSIS

The President's message clearly establishes the need for positive, consistent and adequate support for R&D efforts, both for improving the nation's economy and quality of life, and for reversing the decline in our international competitiveness and leadership. While the message outlines initial actions by the Federal Government, it is important that more comprehensive and definitive actions be planned after the results are available from the numerous assessments, studies and experiments called for by the message.

Nevertheless, some objective observations can be made before the various studies are completed. In

fact, many of the following points merit consideration as the studies progress.

First, with respect to federal financial support to R&D efforts, the planned expenditures for FY 1973 are still \$300 million less than they were in 1967. Indeed, R&D expenditures actually are down to 6.7 percent of the total federal budget, from a high of 12.6 percent in FY 1965.

Second, even with "65 percent greater" federal R&D funds for domestic programs in 1973 than in 1969, there clearly exists no adequate national commitment to a domestic program that even remotely compares to the magnitude of past defense or space programs. While national problems are given recognition, an effective federal mechanism has not yet evolved for defining national goals, not to mention the problems of delineating them and assigning priorities to national domestic programs necessary to achieve these goals.

Such a national commitment could be initiated in many areas. The fields of energy, pollution, health, mass transportation, and many others, present national societal problems, but, for a host of reasons, particularly financial and political, industry cannot initiate effective solutions. Today, federal R&D funds directed toward these areas are fragmented among many departments and agencies. Even though a significant amount of money is being spent in total, it is not focused through a goal-oriented national program.

Third, the emphasis on promoting industry R&D seems to be overly oriented toward stimulating small high-technology firms to engage in research on problems having large commercial potential. While such R&D support may contribute toward fuller employment and a general improvement in the economy, it does not directly address the large domestic problems. This observation is not to denigrate the potential contributions of either small firms or general economic gains. Rather it is to recognize that while small high-technology firms had a phenomenal innovation record during the first three decades of the century, since World War II a list of the most important technological breakthroughs shows that the larger firms, alone or in cooperation with the Federal Government, have developed and commercialized most of the breakthroughs. To some degree this is undoubtedly due to the increasing sophistication, complexity and scale of today's problems, factors not adequately reflected in the message.

Unlike the examples contained in the Presidential message, some of the R&D efforts needed for programs for which the market mechanism is not effective are estimated to approach one billion dollars or more. Until this fact is addressed adequately, it will be exceedingly difficult to resolve some of the major domestic problems facing the nation by bringing needed innovations into play where public benefits exceed private rewards.

Fourth, the recognized need for technological innovation to expand the U.S. markets abroad is cited, but further policy on high-technology exports is not enunciated. Rather, a goal is established for international cooperative efforts in science and technology on common basic problems, such as in cancer research. While such a broad goal is laudatory and hopefully will lead to more rapid progress in curing human ills, the opportunity should also have been taken to announce new policy to help resolve the problem of the U.S. negative balance of trade. Establishing a goal of expanding U.S. competitive high-technology exports would be one of the most direct and effective ways of reversing the downward trend.

And fifth, the planned assessments, studies, evaluations and consideration of alternate federal policies could easily take a minimum of five years, a period in which the U.S. could experience further substantial degradation to its domestic and international economic position. Many studies, both public and private, have already been completed and sound recommendations exist which, if promptly implemented, could improve significantly the short-term opportunities for partnerships which the President is seeking to establish. Unless monitored closely, the tendency will be more toward study than action, a result incompatible with the needs.

SUMMARY

The Presidential message has signaled a new government philosophy, one which should ultimately produce a more objective, goals-oriented approach to federal investment in research and development. A definite commitment has been made to stimulate national R&D on civilian problems and many areas of federal action have been enunciated, although many specifics on how the philosophy will be implemented are missing. Many assignments, too, are focused on studying the "process of innovation" when there

already exists much information and thoughtful opinion on the barriers to application of R&D to civilian problem areas.

In addition to the Department of Commerce being responsible for policy, there remains the need for an assignment of responsibility for program coordination within the Federal Government and an institutional framework for cooperation with state and local governments. The Presidential Science Advisor and the White House Office of Intergovernmental Relations are both responsible for federal, state and local

cooperation with industry and universities. The Department of Commerce has a dual responsibility with the National Science Foundation for the experimental incentives program. Its other responsibilities include exploring new patent policies and coordinating with the Department of Justice on possible revisions of antitrust policy and regulations.

Diffusion of responsibility and lack of focus for leadership action within the Federal Government could well be the major weakness in an otherwise provocative Presidential action.

CHAPTER

3 THE ECONOMIC POTENTIAL OF INDUSTRIAL TECHNOLOGY

The unprecedented U.S. accomplishments in science and technology historically have flourished under the competitive free enterprise system. Given the opportunity, industry always has accepted the challenge and responded strongly to national needs. High technology in particular has characterized industry's response and has given the U.S. an international leadership role in innovation and productivity, as well as a dynamic domestic economy. As the most highly industrialized nation in the world, the U.S. has been the model of technological expertise.

Unfortunately, the nation seems to have forgotten that the unique characteristics of technology are necessary ingredients in any formula for future sustained economic development. As a result, the nation today faces unemployment and lagging productivity rates in most sectors of the economy; other nations are challenging the U.S. for world leadership in the marketplace; and high-technology industries are suffering severe economic stresses, from which many will not easily recover.

Fortunately, however, the President in his message demonstrated his recognition of this problem when he said:

"Innovation is essential to improving our economic productivity—to producing more and better goods and services at lower costs. And improved productivity, in turn, is essential if we are to achieve a full and durable prosperity—without inflation and without war. By fostering greater productivity, technological innovation can help us to expand our markets at home and abroad, strengthening old industries, creating new ones, and

generally providing more jobs for the millions who will soon be entering the labor market."

The potential of industrial technology to assist in the restoration of economic vigor is evident; however, that potential cannot be adequately exploited unless new government-industry partnerships are created, incentives adopted, and international barriers removed. This chapter discusses the basic economic problems identified by the President—international trade, productivity, and employment—and suggests some recommendations for remedial action.

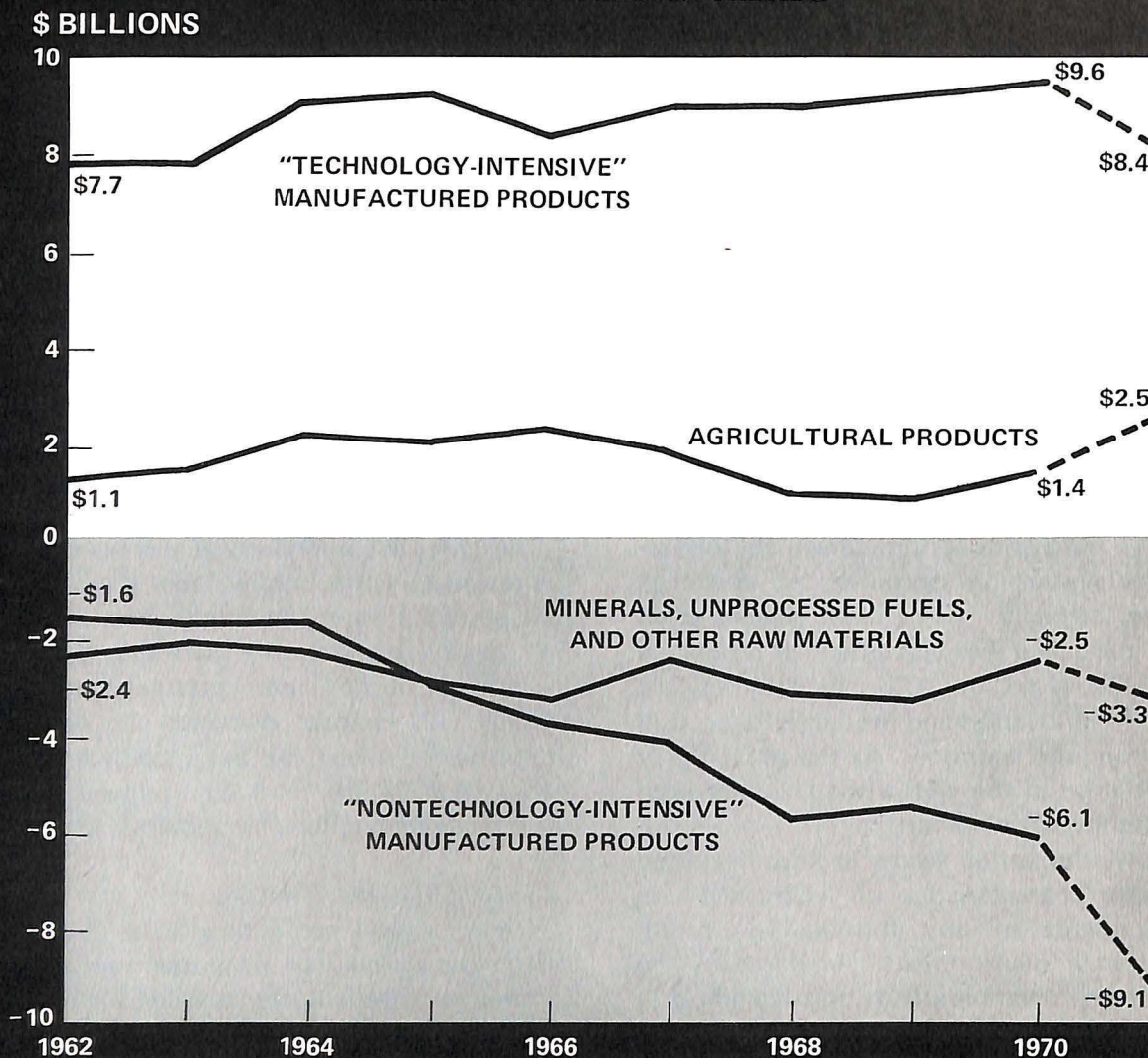
INTERNATIONAL TRADE

Trade balances can generally be divided into four categories: agricultural products, raw materials, low-technology manufactures (textiles, footwear, iron and steel, etc.) and high-technology products (aircraft, electronics, and automotive systems). United States trading trends have historically shown a surplus in agriculture, persistent deficits in raw materials, losses of major dimensions in low-technology products and significant favorable balances in high-technology products. This trend, however, has been recently disrupted, as reflected in last year's international monetary crisis and the positive action currently being taken by foreign nations to stimulate export of high-technology products (Graph 1).

The assessment of the adequacy of U.S. R&D must be made in the light of trends abroad. Foreign competition has become so capable and aggressive that our trade surplus has eroded from the \$5 to \$7 billion level in the early 1960's to a \$2 billion deficit in 1971.

In recent years the major U.S. foreign trade losses

GRAPH 1
U.S. TRADE BALANCE TRENDS



Source: *The U.S. In A Changing World Economy*, Vol. II, Chart 25 GPO, 400-0271.

have been in the low-technology products and raw materials. To date these have been more than offset by relatively stable export surpluses in agricultural products and steadily increasing exports of high-technology products. It is this latter category that is now being threatened by Europe, Japan, and Canada. As recently as 1965, U.S. imports of high-technology products totaled only \$4 billion; in 1971 the level jumped to about \$16 billion. These figures are disturbing, but of greater concern is the fact that *imports of high-technology products are increasing at a greater rate than the export of such products*. As reflected in Graph 2, the U.S. remains the world

leader, but it does not monopolize world trade in research-intensive products.

Government attitudes, initiatives, and policy are the primary reasons for the success of our foreign competitors at the expense of the U.S. Foreign governments are actively removing existing institutional barriers and providing financial support for developments that meet a specified set of criteria promoting economic growth and international trade.

Techniques used by foreign governments to stimulate technologically oriented business activity include direct loans, loan guarantees, grants, interest subsidies, employment subsidies, income tax exemption,

accelerated depreciation, and tax credits. Canada, for example, gives 25 percent grants for capital investment in R&D projects and companies can receive government payments of up to 50 percent of the cost of individual R&D projects. West Germany provides up to a 50 percent special tax write-off for R&D investments and a 10 percent cash investment subsidy. Japan allows up to a 3-year tax holiday for profits on new and important products, and British companies may write off 100 percent of new investments in productive facilities in the year in which they were made.¹

Basic economic principles further illustrate the importance of high-technology and R&D to favorable trade balances. According to Professor Raymond Vernon of Harvard Business School, the recurring pattern in the whole range of goods making up U.S. imports and exports is for the U.S. to play the role of the innovator that is gradually forced to relinquish its lead. In his "product cycle" theory he points out that;

"... as a new product becomes established in the domestic market, it is increasingly ex-

ported, particularly to other high-income, high-wage countries. When those foreign markets reach some critical size, however, it becomes worthwhile to manufacture the product there. At that point, . . . U.S. exports tend to slow down or to be shifted toward lower-income countries. As the product is increasingly standardized and production techniques become well-known, labor costs tend to play a more important role, and foreign producers . . . begin to compete successfully with U.S. exports in third markets. Eventually, the labor-cost advantage may become significant enough so that foreign producers begin to compete successfully in the U.S. market as well."²

The basic implication of this theory is obvious: positive trade balances, like individual industries, are dependent upon innovative progress.

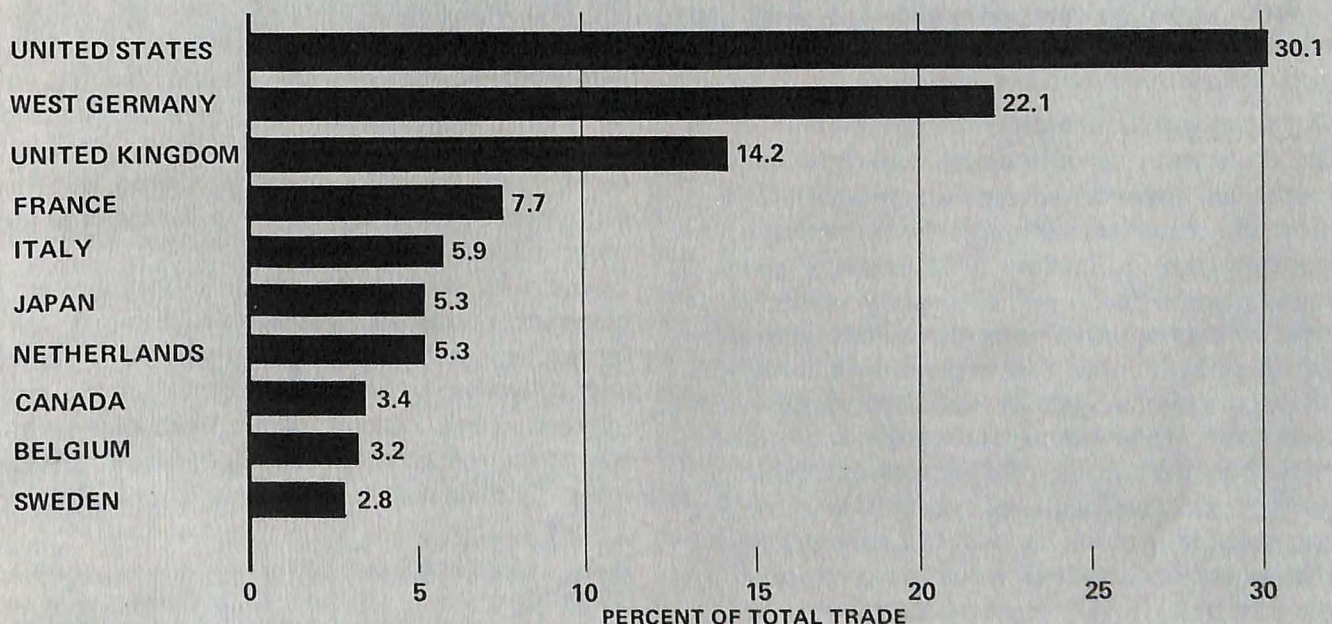
PRODUCTIVITY AND ECONOMIC GROWTH

Economic development of the U.S. is attributable in no small measure to the fast pace of technological progress and its ready adaptation to domestic or

¹Statement by Maurice Stans (former Secretary of Commerce) before the Joint Economic Committee, June 25, 1971, and before the Subcommittee on Science, Research, and Development, July 27, 1971.

²FORTUNE, July 1972, p. 57.

GRAPH 2
TRADE IN RESEARCH-INTENSIVE PRODUCTS
1968-69



Source: International R&D Trends and Policies, Aerospace Research Center, AIA, January 1972, p. 10.

civilian needs. The President noted in his statement that "Americans have long been known all over the world for their technological ingenuity,"—a capacity that "has undergirded . . . our domestic prosperity . . ." This evidence is reflected in several measures of domestic economic concern, but nowhere is it as relevant as in productivity and national growth.

The Council of Economic Advisors noted in its 1972 Annual Report that a strong relationship exists between the amount of R&D investment and an industry's improvements in productivity. The report indicates that for a three percent increase in R&D investment, a one percent increase in productivity can be expected. While it is difficult to pinpoint precisely the impact of R&D on the nation's productivity indices, the rate of productivity growth does correlate with the level of research and development input. Output per man-hour in manufacturing for the U.S. has increased only 8.4 percent since 1967. Japan has soared 52 percent, France 22 percent, and West Germany 15 percent during the same time period. On an annual basis since 1965, the U.S. productivity growth has been only 1.7 percent annually, compared with 4.5 percent in Europe and 10.6 percent in Japan. This trend has been in evidence while our outlays for civil research and development have been declining in "real" terms and as a percent of GNP. Japan, on the other hand, over the past decade nearly doubled its R&D investment, measured as a percentage of GNP.

Further, regarding the potential for R&D to improve productivity, the Annual Report of the Council of Economic Advisors also states:

"Investments in scientific knowledge and in its application to productive uses have become an important characteristic of the American economy. Benefits from the development and utilization of knowledge are many and varied . . . They include entirely new products that enhance the quality of life and new techniques that expand the productivity of the nation's human and physical resources. While an accurate evaluation of those benefits that directly improve economic performance is difficult—to say nothing of the less tangible benefits—it is widely agreed that the group of activities called research and development (R&D) plays a central role in our economy."

There is no question that economic growth closely parallels progress in technology and innovation; technological change is essential to economic productivity stimulation. Indeed, the hallmark of the nation's position among the economic powers of the world has been our success in producing more and better products and services at increasingly lower costs, thus increasing productivity, economic growth, and the standard of living.

EMPLOYMENT

Only expanding technology offers potential for adequately absorbing the nation's vast reservoir of unemployed technical manpower resources. Few reliable data are available, but judging from those that are published, upwards of 100,000 scientists, engineers, and technicians are currently unemployed or underemployed throughout the U.S. When support and administrative personnel are considered along with the multiplier effect which generates additional indirect jobs, the unemployment due to joblessness among technically-oriented people becomes even more acute. One reliable estimate states that "for each job in science and engineering there may be as many as ten jobs throughout the economy which are directly or indirectly dependent on it."³

Since 1969, when employment cutbacks in the technologically-based industries were first initiated, debates have ensued at all levels of industry and government concerning causes, effects, and government responsibility; but none is more pertinent than the fact that most technically educated people were induced to choose their professions as a result of deliberate national policy. Stated federal policies relative to the "cold war" and defense readiness and the space effort implied promises of rewarding careers, not only in the monetary sense, but through a promise of careers in top priority national interest programs, as well.

The fact is that the nation's unemployed technologists constitute a valuable pool of national human resources ready to marshal their individual and collective knowledge on behalf of the national interest. Their current status only represents idle economic resources, whose lack of investment cannot return a dividend in America's future. Potentially,

³Lecht, Leonard, of National Planning Association, Hearings Before the Senate Committee on Labor and Public Welfare, Special Subcommittee on National Science Foundation, S.32, October 26-27, 1971, p. 265.

they represent an economic sector that is capable of reckoning with the nation's current priority programs that have resulted from newly redefined policies. Their re-employment to that end would be an effective force, making a significant contribution to U.S. economic health.

INCENTIVES FOR STIMULATING INDUSTRIAL TECHNOLOGY

From the foregoing it seems obvious to conclude that now is the time for implementing a new approach at the highest government levels for energizing the nation's technological efforts. Actions should be taken to improve our incentives programs for the private sector to revitalize technology and attract its creative skills to the solution of new challenges and problems. The government should adopt a positive policy that would stimulate and encourage R&D and the export of high-technology products. Consideration should be given to such forms of direct federal assistance as loans, loan guarantees, grants and procurement incentives, indirect assistance such as tax incentives for R&D and related capital investments, revised antitrust and patent laws, and accelerated depreciation.

R&D TAX INCENTIVES

In our economic system, it has long been recognized that a tax incentive provides a simple, direct, and effective stimulus to economic activity. There is good reason then to believe that a tax incentive, such as a tax credit, applied to R&D would similarly promote increased investment in R&D, and generate significant economic benefits.

The adverse impact of a declining growth in industry funding is more immediate than a downturn in government funding, since industry efforts are devoted more to product improvement and development leading directly to production and sales, both domestic and foreign. Conversely, if industry funded R&D is given a tax incentive, the positive impact would be more immediate and broadly beneficial for the same reasons.

While precise measurements are difficult, rough calculations of a 10 percent R&D tax credit indicate that it would be of substantial benefit to the nation. Using the 1971 industry-funded level for R&D of about \$12 billion, the U.S. Treasury would forego approximately \$1.2 billion in direct revenues; however, the net impact of the tax would be considerably

less due to induced growth in GNP and national income attributable to the tax credit. There is reason to expect a positive accumulated cash flow position after six to eight years, depending upon the rate of growth in R&D investment. In the intervening years, the tax burden would be substantially less than the annual \$1.2 billion "face value" because the foregone taxes would in turn stimulate GNP by about \$500 million.

Beyond these benefits, however, only the well managed, profitable companies could take advantage of a tax credit. As no credit would be available to unprofitable companies, an incentive would exist for a company to maintain its profitability and thus its capacity for stimulating new developments.

Results in the near term of increased R&D would be improved productivity, as well as new markets, which would result in additional employment opportunities, thus improving the nation's competitive position and materially counteracting current adverse trends in the balance of trade.

A "NATIONAL TECHNOLOGY BANK"

During the last three or four decades, the U.S. has created a number of financial aid institutions for the purpose of promoting economic development and social progress in many areas. These include such organizations as the Small Business Administration, the Export-Import Bank, Farm Credit Administration, and others, where the stated purpose is to promote, stimulate, or protect investments in a given area of economic activity. Precedent has been established, therefore, for the general concept to be applied to the area of technology, and the approach to such federal support can be extracted from the charters of similar organizations.

A "national technology bank" would aid in financing the development of potentially promising products and services for domestic and international consumption. The bank would supplement and encourage, but not compete with, private capital for development programs that offer reasonable assurance of profitability to the borrower and thus assurance of repayment to the bank; however, the bank also would consider the possible domestic and international political implications and the social benefits to the U.S. in approving specific applications for assistance. Such a concept could provide a stimulus to technology in certain areas that would otherwise be difficult to achieve.

ANTITRUST LAWS

In testimony before a Senate Committee recently, former Secretary of Commerce Stans said:

"The high costs and risk of technological development, for example, might well be spread among a number of firms, but our antitrust rules now prevent this by prohibiting joint ventures and joint research."

Antitrust laws and their implementation were originally designed to promote competition. When they restrict the nation's economic growth in export and affect the quality of our technological base, they must be considered as a constraint to competition, particularly when foreign consortiums threaten to make serious inroads in the international markets for many high-technology products.

A comparative analysis of the viable institutional arrangements of foreign countries readily leads to the conclusion that special attention should be given to two possible arrangements which would provide a mechanism for undertaking an effort beyond the capability of an individual corporation and at the same time minimize required public funding support. These might include:

- Establishment of a legally approved joint government/industry organization to provide for the orderly development of a needed national capability, using the systems approach.
- Removal of legal constraints on the establishment of a consortium(s) within the private sector to undertake efforts which have acknowledged high potential international commercial markets.

SUMMARY AND RECOMMENDATIONS

This chapter has illustrated the important role of technology in maintaining the dynamic viability of the U.S. economy: its contribution to our international trade balances, its potential for increasing national productivity and economic growth, and its capacity to generate employment opportunities. While the Presidential statement acknowledges that these are problem areas in our economy, it seems clear that existing policies and coordinating mechanisms are not recognizing or adjusting on a timely basis to the present adverse trends and that new direction and increased emphasis will be required to reverse them.

In order to meet the increasing competition from abroad it is recommended that a national goal of

maintaining a positive trade balance be implemented immediately. Such a goal should be supported by aggressive new export policies which emphasize promotion of internationally competitive high-technology products in ways that will contribute materially to increased international sales by the U.S.

Among the elements that should be included in this international policy are:

- Development of innovative government/industry relationships in high-cost, high-risk technological products having high economic return for the nation;
- Intensification of efforts to eliminate tariff and non-tariff trade barriers;
- Insuring that adequate financing at rates competitive with those offered by other nations is available for both civil and military exports; and,
- Progressive liberalization of trade practices and enhancement of the exporting environment.

It also should be recognized that economic incentives must be developed and made a part of any overall national effort designed to achieve the broad objectives outlined above. Such incentives should focus on:

- Establishment of an independent government financial organization such as a "national technology bank" which would provide the private sector with financial aid, either through guarantees or direct loans, for the purpose of stimulating additional private investment in R&D for both public and private programs of national and international importance to the U.S.;
- Initiation of a program of tax incentives capable of stimulating additional private investment into industrial R&D activities, with particular attention to an R&D tax credit; and,
- Examination of the nation's antitrust laws and their administration to determine whether revisions should be effected to stimulate R&D.

It is understood that the role of technology is all important as a stimulant to economic growth and productivity. The President fully recognized its impact and proposed many varied actions for implementation. This paper notes, however, that other actions are essential if the full intent and objective of the national program is to be fulfilled.

The above recommendations, coupled with the planned and contemplated actions of the Presidential program, will make tangible contributions to a renewed and sustained economic growth pattern.

CHAPTER

4 BARRIERS TO THE UTILIZATION OF INDUSTRY ON MAJOR DOMESTIC PROBLEMS

Historically, federal support of R&D has been in those areas where state and local jurisdictional interests are clearly secondary to national interest. National security is such a case and one where technology has made a major contribution. Except for the U.S. space effort and the national highway program, there have been few instances in recent history where the Federal Government has committed major resources to non-military programs.

Yet the nation's problems at the state and local levels have continued to grow, reaching serious proportions. There is not only great public concern but also a broad willingness to accept the resolution of these difficulties as being in the national interest. Thus, national priorities are shifting and domestic problems such as environmental management, health systems, transportation, housing, education and urban development are demanding, and receiving, greater attention.

GOVERNMENTAL RESPONSIBILITY

The Federal Government has been seeking means to solve domestic problems related to high-priority areas of national concern, and on the basis of past experience it has recognized that, in many cases, the nation's technological capability is a valuable instrument to help achieve such goals. Federal agencies, therefore, have been extending their areas of interest into even wider fields of scientific and engineering endeavor than ever before. Industry has broadened its R&D interests and investments as well. But with all this increased attention there are few who would say that significant progress has been made toward the resolution of even a single major domestic problem.

A major missing element in an otherwise thoughtful process is a designated mechanism through which continuing analysis of national problems having a high technological component can be made, priorities recommended, and Congressional approval obtained.

A prime example is found in the recent endeavor of the Domestic Council to recommend major programs for inclusion in the special technology message to Congress. This effort amply demonstrates that such a mechanism for analysis and selection of priorities does not exist in the Federal Government, for after a most exhaustive search only a very limited group of relatively small projects was selected for announcement. Acknowledging that the *ad hoc* review process ran into delays, an Office of Science and Technology staff member said that this "related directly to the difficulty of tying particular programs to our specified national goals."⁴

In an environment of constant reordering of national priorities, a top level mechanism to continuously relate specific programs to national goals or objectives appears to be an absolute necessity. Without it, the nation's diverse resources are apt to continue to be diffused rather than focused, the problems to worsen rather than improve.

For much the same reason, responsibility for national planning must also rest with the Executive Branch of the Federal Government. While the nation's economy is not a centralized, planned economy—nor should it be—better overall governmental planning is needed to identify and accommodate the interplay of goals, priorities and R&D

⁴John B. Connolly, *National Journal*, May 6, 1972, p. 758.

programs. This need was recognized by the President when in 1970 he established the Domestic Council and the International Economic Policy Council alongside the existing National Security Council (NSC) and the National Aeronautics and Space Council (NASC).

One major difference, however, between the Domestic and International Economic Policy Councils on the one hand, and the NSC and NASC on the other, is the relationship of the Councils to Executive Branch departments and agencies. Essentially, NSC's principal area of interest corresponds to that of the Department of Defense, and NASC's to that of the National Aeronautics and Space Administration. Thus the lines are clear for relating security or space programs proposed in DOD or NASA to established national goals or objectives. The other executive agencies and departments have no such direct, simple relationships for tying their particular programs to national goals developed by the Domestic and International Economic Policy Councils.

The complexity of economic and quality of life problems involves several executive departments, each with significant roles. For example, Interior, Agriculture, Commerce, Health, Education and Welfare, Housing and Urban Development, and Transportation Departments and the Environmental Protection Agency are all directly responsible for some aspects of air and water pollution. One possible approach for penetrating this complex organization structure would be the designation of an executive department or agency as lead agency for a specific national goal or objective. The designated agency, working with the President's policy councils, would not only assist in directing responsibility but also would provide a mechanism for better utilization of the associated multiplicity of federal funding. Obviously all goals could not be achieved without major increases in federal funding; however, contributions of related budget line items in many of the separate agencies and departments, if aggregated by overall national programs (such as safe, pollution-free urban mass transportation) could provide a significant start toward achieving these goals.

FEDERAL, STATE, AND LOCAL GOVERNMENTAL INTERACTION

Although many coordination problems exist at the federal level, jurisdictional conflicts, overlap, and gaps among the regional, state and local governments present an even more difficult problem. Assuming that adequate structural organization with technical

expertise will evolve within each state, the problems of coordination and cooperation among the various jurisdictions must be faced. Many of the civil problems involve natural resources such as air and water, which do not respect political boundaries. For example, solutions to air or water pollution problems for New York City would be ineffective without the cooperation of the state governments of New York, New Jersey and Connecticut.

With the possible exception of a few regional organizations, a common basis for cooperative action among the states does not presently exist, nor is there any well-developed basis for interchange and cooperative science and technology effort between the states and the Federal Government. Direct federal action in policy areas which historically have been the prerogatives of local authorities, is certain to arouse hostility or non-cooperation. Many approaches, such as grants-in-aid and revenue sharing, are being discussed and tried in attempts to find the proper relationship among the various government levels. Providing federal funds alone, however, is not enough to ensure effective action at the state and local levels, because of the technical and jurisdictional problems. Alternatives similar to the federally legislated standards for automobiles are often acceptable substitutes to direct funding and should be considered for other program areas.

The solution of national problems will, of necessity, involve the Federal Government in one form or another. A wide range of federal involvements is possible. Three important ones are:

- Federal planning, federal funding, development and operation (e.g., defense, space and air traffic control);
- Federal planning, development and demonstration, with operations directed at the local level (e.g., nuclear power generation); and
- Local planning, development and operation with federal guidance and funding assistance (e.g., highways).

Appropriate and acceptable involvement, of course, must be determined separately for each major national program. This action will take time, but national problems demand that decisions be made to implement a course of action which holds promise for solution.

BARRIERS TO MARKET AGGREGATION

From time to time during the past several years,

industry has been sharply criticized for not voluntarily redirecting its efforts on a large scale to the solution of domestic problems. Similarly, several so-called "conversion" bills have been submitted in both houses of Congress in an effort to either direct or attract defense firms to civil pursuits. Both actions are misguided for basically the same reason: misunderstanding (or naiveté) regarding the free market mechanism. Fortunately, the present interest in "incentives" to motivate industrial effort is due principally to the recognition by the Executive Branch that industry has to be responsive to market and economic conditions and that rewards must be commensurate with risk.

Today, the most significant barrier to the utilization of industry in the resolution of major domestic problems is simply that there is no clear market for the products or technology appropriate for solving those problems. As the Joint DOD-NASA Civil Aviation Research and Development (CARD) Study noted in a key finding:

"Effective market demand involves the readiness of people to pay for what they want (their needs), and the willingness of producers to commit resources to satisfy those needs. There is a disparity between established civil aviation needs for new technology and their satisfaction; recognized needs for new aviation technology have not been translated into a clear market to which private enterprise can respond. Without definite markets that offer opportunity for gain commensurate with the risks involved, private industry has rationally avoided directing its resources toward meeting needs. . . ."⁵

This finding for the civil aviation market is just as applicable to those civilian problem areas addressed in the President's message. In a free competitive economy, entry of any firm or industry into a particular market, if it is to prove successful, must be based on the present or potential existence of *effective demand*. The "pay off" from such demand ultimately is from the sale of products and services produced—not from the research and development required to create prototypes. While it is not broadly recognized, the motivation for any firm entering the

civilian market is for production business, not for research and development alone.

Effective demand for products or services for the major civilian problems does not currently exist. The present market for technological solutions to civilian problems consists of numerous small customers, who in most cases are unsophisticated in technical terms, and in many cases suspicious of technologists and their products. Authority, and what funding there is, are widely scattered throughout many cities, agencies, offices, and jurisdictions; consequently, the risk of investing in R&D without any degree of assurance of production potential is very high.

The principal risk, however, is in undertaking the research and development effort itself, even without considering the lack of an assured production market. This is because commercial R&D activity usually concentrates more on refinements of existing technology, whereas solutions to the civilian problems addressed by the President's message will involve greater complexity and sophistication, even development of new systems. Solutions to these problems generally will mean breaking new ground in a particular technical-economic-social area, and therefore the outcome on costs, quality and timing will be more difficult to predict.

While many of the problems which manifest themselves at state and local levels will have common technical solutions, there is no one magic solution to the market barriers just described. In cases where the national interest is demonstrated, it seems apparent that sufficient R&D effort should be federally sponsored to provide the problem analysis and aid in establishing national problem priorities. Similarly, federally sponsored R&D effort should be directed toward establishing an adequate baseline definition of the problems—one against which progress can be assessed. Only then can a cogent plan and R&D program be established to provide a solution, whether through a strategy of standardization, prototype demonstration, full scale development, or some combination. In many cases it will only be through a demonstrated system that sufficient stimulus can be provided local governments to recognize how to solve their problems and give them the ability to obtain financing.

Regardless of the plan established for a national program, the organizational and management technique of a single government "systems (program) manager" as used for defense, space and nuclear

⁵Joint DOT-NASA Civilian R&D Policy Study, *Institutional Factors in Civil Aviation*, January 1971, p. 3.

programs is definitely applicable. Within the concept of a lead agency, that organization could designate a single, top level manager with total implementation authority and responsibility oriented toward a national goal or objective. The principal benefits of the concept are that the office works only on the one problem, is specifically tailored for that task and goes out of business when the job is done. The single purpose, limited life organization permits chartering which can cut across traditional institutional, organizational and even geographical lines when placed at the highest level of authority necessary to get the job done. It is a valuable and proven technique for solving large scale, long term, complex problems.

SUMMARY AND RECOMMENDATIONS

This chapter has attempted to show that there is evolving within the Executive Branch of the Federal Government and among the various other levels of government, an organizational alignment and funding arrangement for addressing the national domestic problems related to quality of life and the economy. This evolutionary process is, however, inherently very slow and often ineffective. For this reason, it is appropriate that the Federal Government have the basic responsibility for the establishment of national goals and objectives and the leadership in bringing them to a demonstrated solution.

It is specifically recommended that the identification of national goals and objectives be made a direct responsibility of the President's policy councils.

It is further recommended that the responsible policy council assign to a specific Executive Branch

department or agency the lead responsibility for a specific national goal or objective.

To further focus responsibility and provide a clear management structure within the Executive Branch for a national program undertaken to realize a national goal or objective, it is recommended that a single government system manager be designated for each national program.

The purpose of this report is to set forth methods through which industry can be utilized in effective technological solutions to the national problems. This chapter has identified the lack of market aggregation as the major barrier to the utilization of industry. Through the organizational concept previously discussed, it is recommended *that the Federal Government take positive steps to aggregate the widely fragmented markets* through one or more of the following actions:

- Develop technically, economically and politically feasible standards;
- Demonstrate technological application through prototypes;
- Develop operational system solutions;
- Support means for production acquisition by state and local governments.

This chapter has focused only on the major institutional, organizational and market barriers to the utilization of industry to effect technological solution to national problems. Other barriers of an administrative policy or regulatory nature also exist as non-incentives for industry involvement. These additional barriers are discussed in the next chapter; while not as broad as those presented in this chapter, they are much more susceptible to early solution.

CHAPTER

5 FEDERAL PROCUREMENT POLICY INCENTIVES

As the President's technology message noted, the role of the Federal Government in shaping American science and technology is pivotal, because of the total national expenditures for research and development 55 percent is funded by the Federal Government. Equally as important are the policies of the federal procurement system through which about \$100 billion per year of goods and services are acquired from industry, including over \$8 billion annually of federally funded R&D, all subject to these policies.

Federal procurement policies (as found in literally tens of thousands of regulations, directives, instructions, procedures, manuals, management systems, data requirements and more than 4,000 federal statutes which are either directly or indirectly applicable) combined and cumulatively have an immeasurable impact on technological innovation. The President noted this in his special message when he said, "... excessive regulation, inadequate incentives and other barriers to innovation have worked to discourage and even to impede the entrepreneurial spirit."

In this chapter, three major cases of excessive regulation will be discussed. The removal of many of these barriers could be effected immediately within the Executive Branch, though specific legislative actions are recommended to eliminate them.

INDUSTRY FUNDED RESEARCH AND DEVELOPMENT

"The direction of private scientific and technological activities is determined in large measure by thousands of private decisions—and this should always be the case." This statement by the President is

a proper and sound statement of federal policy. However, a number of Executive Branch departments and agencies have promulgated regulations on government contractors' independent R&D. These regulations preclude or limit private decisions. The most onerous of these regulations treat the research and development funded by industry as "Independent Research and Development" (IR&D) and "Bid and Proposal" (B&P). They have imposed arbitrary and artificial controls on critical business decisions, which are believed by industry to be strongly detrimental to the national well-being.

IR&D and B&P are essential and normal costs of doing business. IR&D is that activity undertaken by a company to improve its capability to create the products of the future, i.e., to remain competitive. Every company, whether its market is primarily commercial or it sells primarily to the government, must engage in this effort if it is to survive. This is also the area in which private industry makes its greatest contribution to the advancement of the nation's technology base. For the government to restrict or penalize this kind of activity within the industries that provide its products and services is the most shortsighted type of economizing.

It is axiomatic that a business must generate income in excess of all of its costs and expenses or it will not survive. A business generates income by offering products or services which customers are willing to purchase. The prices of those products or services include the costs of producing and marketing them plus a factor to serve the role of profit—indispensable in a free-enterprise economy. The costs include the labor and materials which are used in

producing the products and services and allocable shares of the many indirect (overhead) expenses necessary to operate the business. Included in these indirect expenses, for example, are managerial and clerical salaries and wages, payroll taxes, depreciation and maintenance of property used in the business, utilities, insurance, taxes and research and development.

"Independent" is the key word in distinguishing the nature and value of IR&D. It means the company management's own evaluation of what it must do to remain technologically competitive in the future balanced against the competitive implications of the cost of so doing. That is perhaps the most difficult, and in the long term, most significant decision of management in any enterprise. It also represents that element of managerial judgment and skill most valuable to the customer, whether commercial or governmental. In no other way does a company put its future on the line to the degree it does in making such decisions.

Obviously, no customer or other outsider could even approximate the knowledge and experience involved in this peculiarly internal decision, nor, as the President pointed out, should he want to. The cumulative effect of the thousands of such independent judgments made throughout American industry constitutes the font of our overall national technological creativity and advance.

There is no uniform policy or regulation within the Executive Branch covering IR&D and B&P. AEC and some offices in HEW do not allow these normal costs of doing business, thereby precluding the effort unless it is specifically authorized by contract. NASA, on the other hand, accepts these normal costs.

DOD policy is now governed by P.L. 91-441, Section 203, which imposed the following constraints on the cost recovery of IR&D and B&P. First, is a test of potential relationship to a military function or operation as decided by the Secretary of Defense. Second, the law requires that a technical evaluation of contractors' planned efforts be made. Finally, the law requires an advance agreement with each company which during its last preceding fiscal year received more than \$2 million of IR&D or B&P payments from DOD. The law also provides that if an advance agreement cannot be successfully negotiated prior to or during each fiscal year, the payments for IR&D and/or B&P shall be in an amount substantially less than the company or product division would otherwise have been entitled to receive.

What are the effects of all this restrictive regulation? They are many, and surely farther reaching than the authors visualized or intended. For instance, IR&D and B&P are being limited with minimal, if any, regard to an overall national technology program emphasis. The attempts to prejudge the value of IR&D efforts tend to focus attention on today's programs to the detriment of tomorrow's. They have the effect of limiting efforts to proven areas of technology and discouraging exploration into new and unproven areas. They unnecessarily increase administrative costs to both government and industry. A highly constrained IR&D/B&P program limits the companies' viability and ability to compete. And finally—and most importantly—the constraints have the effect of detracting from nationally needed diversification efforts, limiting the rate of technology advance and hampering the expansion of the technology base.

COST SHARING

Counter to the long-standing principles of fairness and equity in government contracting is the recent pressure for industry to share the costs of research in certain types of federal contracts. Cost sharing is as the name implies—the industrial performer of the contract shares the research costs with the government, either directly or by accepting reduced fees. Philosophically, this presents a radical departure from past practice; practically, it is causing an unfortunate restraint on innovative efforts.

Cost sharing has traditionally been an accepted practice between the government and universities and non-profit organizations. The original theory of the practice is not really known but it was broadly accepted. Perhaps this is because such cost sharing was usually nominal, in the range of only one to five percent. In 1970, without warning, hearings, or public explanation, this provision was extended for the first time to cover industry as well. Public Law 92-78, Section 504, was the vehicle, though it pertained only to the independent agencies. It imposed mandatory cost sharing on research contracts resulting from unsolicited proposals submitted to those few agencies. In December of the same year, the Office of Management and Budget developed OMB Circular A-100 to extend the provision of P.L. 92-78 to all departments and agencies within the Executive Branch. Principles aside, the Circular was issued on December 18th.

The statutory requirement created an unfortunate

restraint on innovative efforts in that it acts to discourage contractors from suggesting, through unsolicited proposals, research efforts which they believe to be within the scope and interest of government agencies' responsibility. The extension of this statutory requirement to all departments and agencies compounds the significance and impact of this barrier.

The profit motive underlying our free enterprise economy can hardly be squared with reduced, eliminated or negative fees for providing the government with goods or services it requests. DOD has long recognized this in its Armed Services Procurement Regulation by forbidding cost sharing in all contracts, with one exception. That exception applies to those rare cases where a company would clearly stand to make an extraordinary subsequent profit because of the original contract. Even in those instances, approval had to come from the head of the department.

In spite of the restrictions, however, DOD and other agencies have, almost routinely, practiced other forms of cost sharing. One way this comes about is with solicited R&D work where the government buyer, motivated to achieve the lowest price for the government, in effect auctions off technology contracts to the lowest bidder. These contracts are usually firm-fixed-priced and the cost sharing comes about by requiring efforts in the contract statement of work which knowingly would cost more than the price of the contract. Another is when the contractor absorbs a percentage of the total contract cost or assumes responsibility for all costs over a fixed ceiling. Motivation on the part of both government and industry is fairly obvious, often well intended and, in the short run, may even appear reasonable. In the long run, however, a compromised principle may exact a higher price than will prove to be acceptable. Both the formal and informal types of cost sharing with industry should be eliminated.

PATENTS

A Presidential Patent Commission in 1966 found that the incentives of a patent system stimulate investment in research and development and "there is no practical substitute for the unique service it renders." The possibility that the performance of research and development may result in a patent and assure the innovator a share of a particular market is indeed a strong stimulus to the investment of private funds in both research and development. The fact that so many U.S. firms obtain foreign patents, and

foreign firms U.S. patents, is indicative that such incentives cross national boundaries as well.

The government has long recognized the value of patent incentives. Principally through the efforts of the State Department, the Senate is now considering a patent cooperation treaty which would facilitate obtaining patents and might eventually lead to a worldwide patent system. Industry is in general agreement with the proposed treaty.

The government in its contracting, however, does not always fully utilize patent incentives; indeed it often compromises available incentives. This occurs when the government acquires the title to inventions and patents made during contract performance, either as required by statute (e.g., The Space Act of 1958) or directive (e.g., the President's Statement on Government Patent Policy). This "title policy" of the government has caused many qualified and competent companies to refrain from competing for such government contracts. Moreover, studies have shown that this policy has resulted in discouraging privately funded research and development in fields where the government also is conducting research.

Because the government has amassed a significant number of patents under its "title policy" (It is by far the nation's largest patent holder) there is a sense of obligation to do something with such patents. As a result, the government has now entered the patent licensing business in competition with private industry. Although the President's policy encourages the utilization of government-owned patents through licensing or dedication to the public (i.e., a waiver of the government's rights in a patent) it is significant that dedication has never been implemented.

Another area in which the government compromises the patent system is through constraints placed upon the full utilization of privately owned patent rights. This occurs when a patent owner seeks to recover his investment in research and development through granting royalty-bearing licenses. Here the courts, in many instances, through litigation brought by the Justice Department, have placed severe limits on licensing. Congress has considered, and industry favors, the enactment of legislation which would remove certain of these constraints.

The President's message noted that he had directed that government-owned patents may be made available to private firms through exclusive licenses where needed to encourage commercial application. While the intent of such action can be supported, the inequitableness of taking away a non-exclusive license

from the inventor to give an exclusive license to another party cannot be supported. NASA in implementing this Presidential direction has attempted to limit by area of application both the exclusive license and the reduction of the non-exclusive license. Other departments and agencies, however, have not taken this implementation view and again we have a non-uniform federal policy.

SUMMARY AND RECOMMENDATIONS

This chapter has discussed three specific cases of "excessive regulation, inadequate incentives and other barriers" which should be given immediate consideration in the implementation of the President's technology message. They are:

- Industry Funded Research and Development,
- Cost Sharing, and
- Patents

Recognition of the significant role of industry in providing the needed technology is important. Industry currently provides 40 percent of the nation's R&D funds and performs more than 70 percent of all R&D effort.

To realize the benefits from the "thousands of private decisions" that industry makes regarding its R&D investment, it is recommended that:

- Arbitrary controls currently imposed on government contractors' Independent Research and Development be removed. Specifically, that Section 203, originally introduced in P.L. 91-441, be amended to remove restriction on the recovery of IR&D and B&P costs which are reasonable in amount and properly allocable;
- A uniform Executive Branch policy be issued which recognizes that natural competitive forces

automatically provide the only appropriate controls over IR&D costs and that accountability to the government of such expenditures is adequately provided for in long-standing operating experiences.

To eliminate the inequity of current cost sharing requirements and practices, it is recommended that:

- Section 504, originally incorporated in P.L. 92-78, be amended to remove the mandatory imposition of cost sharing on research contracts resulting from unsolicited proposals;
- OMB Circular A-100 be rescinded and a uniform Executive Branch policy be issued which prohibits cost sharing on all government contract work performed to meet agency requirements, or in the national interest.

With respect to patents, the government should undertake an examination of the U.S. laws and policies relating to patents and make revisions to achieve a fuller utilization of patent incentives by removing or modifying the inhibiting factors in "title policy" and patent licensing. Specifically, it is recommended that:

- Legislation be provided to either dedicate to the public government-owned domestic patents, or grant general non-exclusive royalty-free licenses under such patents;
- Legislation be provided to clarify Congressional intent in existing statutes as to the allocation of rights to inventions made in the performance of government contracts, and to preclude the acquisition or dilution by the government of contractors' rights in background patents;
- A uniform federal policy be established which equitably allocates the rights to inventions made in the performance of government contracts.

CHAPTER

6 NATIONAL POLICIES

In this report, the President's technology message—its charge, its challenge, and its promise—have been reviewed from an industry perspective. Specifically, how the technological talent of American industry, especially high-technology industries, can be utilized for the benefit of the nation has been examined and a number of significant barriers to this utilization have been identified.

It is recognized that there is no one easy or simple answer to eliminating barriers, inadequate incentives or excessive regulations. Nevertheless, based on study and experience a number of approaches, alternatives and specific recommendations have been presented in Chapters II through V.

In this final chapter, each of the subjects discussed in the preceding chapters is summarized and a number of overall recommendations are presented.

Based on the philosophy and concept expressed in the President's technology message, a new perspective will emerge if the Councils in the Executive Office of the President address our national problems through firm, positive and coordinated statements of policy. From these actions, the means can be found for the new partnerships between industry and the nation's

interests. The industry can and will support the effort. The benefits will be felt in such areas as the solution of domestic problems, productivity, international trade and government procurement.

TECHNOLOGY

The nation's total research and development effort has been declining as a share of the GNP, chiefly because the Federal Government has been cutting expenditures. In the long run, the trend will have a serious effect on our economic growth, our national security and our international position.

The President has recognized the important role of technology in the past, present and future viability of the U.S. economy—its capacity for solving problems, its generation of productivity, its contributions to our standard of living, its essentiality if we are to remain preeminent among industrialized nations.

Today we have severe unemployment in the fields of science and engineering. Uncertainties have eroded youths' interest in technology. Other nations are challenging us in the world marketplace. Many high-technology industries in the U.S. are suffering severe economic stress.

Unless a comprehensive national perspective of technological needs and opportunities is developed and translated into action, these problems will increase rather than diminish.

New approaches are needed and firm decisions are required at the highest level to revitalize our technological effort and to attract industry's creative skills to the solution of new national challenges. Adequate funding and budgets to meet the goals successfully are most essential. Hence:

A long-range national technology strategy should be formulated. The strategy should be responsive to the nation's needs and should be supported by both a mechanism that sets forth research and development goals, objectives, priorities and programs, and adequate funding.

DOMESTIC PROBLEMS

We have in this country major domestic problems in such areas as housing, pollution, crime, education, transportation and waste disposal. They have not been tackled, privately nor publicly, in ways to achieve dramatic advances by applying technology to their solution in concerted efforts. Many government agencies share the responsibility for these problem areas and some appear to lack the ability to utilize R&D effectively to explore promising concepts, develop applicable systems, or obtain adequate budgetary support.

While many of these problems manifest themselves at state and local levels, it must be recognized that many problems will have a common technical solution, or at least broad applicability, throughout the entire nation. In such cases, it seems clear that the Federal Government must assume responsibility in the public interest for bringing R&D to bear on these current areas of impasse. They need to be resolved in the same manner that space and defense problems have been attacked in the past.

The biggest problem is that the market is missing. It might even be called a non-market, because it is so fragmented and disconnected. Authority, and what funding there is, are scattered widely throughout many agencies, offices and jurisdictions. Therefore:

A continuing national program to identify major domestic problem areas having potential for solution through technology should be established, and demonstration programs should be funded and initiated in a concerted effort to find their solutions.

ECONOMIC TRADE

A strong private industry technology effort is basic to improved economic growth and national productivity. For a number of years, many foreign countries have actively promoted national goals and economic expansion through promotion of industrial technology investments. Their techniques include grants to industrial firms, government payments of up to 50 percent of the cost of individual R&D projects, special tax write-offs, and tax holidays for profits on new products. As the U.S. shifts its goals and priorities, technology is becoming more and more recognized as a potential instrument of national policy.

While the Presidential statement acknowledges the importance of technology to productivity and the need for new incentives, the current efforts of the National Bureau of Standards and the National Science Foundation to define the new incentives are limited in scope. Therefore, the following policy objective would be appropriate:

Positive new incentives which encourage industrial investment in technology on a broad basis are essential to continuing economic growth and increased productivity.

INTERNATIONAL TRADE

Foreign governments are actively removing policy barriers that impede sales abroad of their high-technology products, and they are providing financial support to their industries to promote export sales.

In this effort to stimulate America's exports, a number of policy approaches are evident. The U.S. must do what it can to discourage restrictive efforts, such as those that come out of bilateral and retaliatory negotiations. We must promote free trade in international markets.

U.S. policy must recognize that foreign competition includes competition in the financing of international sales. If American exports are to compete equally, they must be able to enter the market supported by an export finance policy at least equal to that of other nations. The recent expansion of funds for export credit financing through the Export-Import Bank will be helpful.

Effective U.S. competition in the export market also will be helped if the government will financially support selected development programs. When the project is in the public interest, when foreign governments are financing the competitor and U.S. industry cannot raise funds from private sources, federal

assistance can be justified. The development of the Concorde, Mercure and A300 airbus aircraft are illustrations of government-subsidized foreign competition.

In short, the new policies should support industry efforts to sell abroad, not restrain them. For these reasons:

A national goal of maintaining a positive trade balance should be implemented aggressively. This goal should be supported by positive export policies which emphasize promotion of internationally competitive high-technology products in ways that will contribute materially to increased international sales by the United States.

GOVERNMENT PROCUREMENT

The policies, orders, procedures, directives, reporting requirements and other regulations that govern the annual \$100 billion federal procurement of goods and services, including R&D, have proliferated over the years. They are costly for both the seller and the customer. They try to ensure that the customer—the government—gets real value and performance for the price. Industry shares this objective, but it also has another: the profit it earns must be enough to keep it viable and sustain its commitments.

The practical result of the rules and regulations now in effect runs counter to the basic objectives of the procurement system (which is really a non-system since it was not consciously designed to take the form and dimensions it now holds). Contracting officers seek in negotiation to get prices, quantities, profit rates, delivery schedules, payment schedules and contract terms that they believe best protect the public interest. When the price is lowest, they tend to feel they have achieved this end, other effects including ultimate performance of the contract notwithstanding.

But the contracting officer is not required to exercise concern over the success of the product or about the overall economic health and viability of the contractor, or the industry. Yet the health of the free enterprise system is essential if industry is to maintain its ability to fulfill national security needs, to sustain other contracts, develop new products and enter new markets.

It has become abundantly clear that merely operating the government procurement system this way has led to a host of contracts whose terms on the surface may seem unexceptionable, but whose collec-

tive impact has proven detrimental. This system has reached such drastic proportions, with such excessive detail and costs, that the time has come to confront the problem at the most fundamental level. This means, in short, that both government and industry must agree to seek basic, positive and meaningful improvements. At a policy level, this objective should be made clear:

Government procurement principles, policies, regulations, and practices should all be cast so as to provide positive support to the successful and efficient attainment of national needs. This will require the elimination of unduly restrictive and counterproductive requirements.

To carry this out, government and industry should work jointly to draft and enact into law a set of fundamental principles governing all federal procurement actions.⁶ These should strive to achieve efficiency, along with protection and equity to both buyer and seller, in government contracts.

The principles should recognize the economic and technological facts of life in the 1970's. They should reflect the higher risks, uncertainties and capital requirements involved in meeting the government's demand for goods and services. They should ensure that adequate profit opportunity is contractually established, preferably at levels and amounts comparable to commercial rates. They should allow for contractor costs of doing business when these costs are the kind passed along to the customer in ordinary commercial business. New government contracting principles and policies must acknowledge these facts. Without them, industry will lack the stable foundation it needs to continue its contribution to the national need.

PERSPECTIVE

This study has primarily discussed technology as a national issue and its role in achieving America's goals and priorities. The importance of technology to the nation's future and well-being has been formally recognized in the President's March 16, 1972 mes-

⁶For elaboration, see *Federal Procurement Principles: A Proposal in the National Interest*, AIA Aerospace Research Center, November 1971, which was developed to open such dialogue and initiate action. It deals with such fundamental government-industry relationships as competition, sovereign and monopsony powers, regulation and redress from inequities, and addresses other critical factors such as allowability of costs, negotiation, pricing and profits.

sage. There is promise that the government will increase support for research and development.

However, it will also take policy changes, enunciated and directed from the highest level, to recover lost technological and economic momentum and to reorient our industrial and technological talents. We must tackle growing national problems with the same purpose, vigor and talent that went into our defense and space programs if they are to be adequately resolved.

With changes in policy, enunciated at the top and carried out to the bottom of the pyramid that stretches from concept to practical application, technological capabilities can be reoriented to focus on

new problems, drawing from the lessons of defense and space.

Without these changes in policy, there will be continued loss of our technological base, which has already been seriously eroded, and of economic progress and benefits. Thus the actions proposed in this study distill into one major conclusion:

Positive policy actions by government can restore lost technological momentum in the United States. Regained, this momentum will ensure that both government and high-technology industry, working together, can move effectively toward the solution of many of the priority problems confronting the nation.



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