# FINANCIAL DIALOGUE

# BETWEEN

# GOVERNMENT AND INDUSTRY





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This report reviews U. S. Legislative and Executive Branch actions initiated during the past quarter century to upgrade technological competence, innovation, and economic competetiveness in the industrial marketplace. It discusses and analyses some recent actions aimed at expediting cooperative arrangements among and between government, industry, and academic communities so as to minimize risk, enhance common purposes and objectives, and better meet national economic interests.

The report introduces the concept of a product-innovation spectrum of activities; a Manufacturing Process Spectrum of activities; and a spectrum of Financial Support Mechanisms, as templates through which the utility of various financial mechanisms can be assessed. It highlights that financial mechanisms must be custom-fitted to match the life-cycle phase in the activity spectrums to be effective. Detailed analyses of actual past cases, ranging from support for synthetic rubber plants in WWII to support for Sematech, an industrial consortium for improved manufacturing of large memory "chips", are provided.

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# I. INTRODUCTION

## A. Historical Perspective

Interest in upgrading the technological competence of American business and industry has no formal historical beginning, though government intervention in the marketplace for just such a purpose has been a "front and center" item since at least 1963. In that year, the Department of Commerce proposed the so-called Holloman Civilian Industrial Technology Program (CIT), (so named for Undersecretary Herbert Holloman) which led to enactment of the State Technical Services (STS) Act of 1965, a part of President Johnson's Great Society Program.

The 1965 Act was intended to promote economic growth through accelerating the dissemination to, and use of, scientific and technological knowledge by industry; it was modelled after the long-enduring agriculture extension service system of the nation's land grant college program aimed at effecting such technology transfer. The STS Act, did not, however, survive the rigors of the "new federalism's politics", and succumbed in 1970. Despite such instances of earlier setback, interest continued to grow as evidenced by such reports as the 1966 Report on Technology and the American Economy (focusing attention on the interrelatedness of automation and unemployment), and the well-regarded 1967 Charpie Report, considered to be a classic study on the subject of federal policy design for stimulating innovation in the industrial marketplace.

The period from 1970 to the present has been marked by a zig-zag course of interest in bringing the benefits of new technology and innovation to business and industry through formal government action. President Nixon, for example, gave firm standing to the topic through delivery of the first Presidential message on science and technology in 1972. In 1976, President Carter sent the Congress its first annual science and technology report. Given President Carter's obvious interest in the subject matter, it was a short step for the Department of Commerce to attempt implementation of a number of initiatives including establishment of a

Cooperative Generic Technology Centers program, and creation of the Center for Utilization of Federal Technology.

These, and other actions discussed subsequently provide a variety of perspectives on appropriate government intervention in the marketplace. In the last two decades, the Congress and the Executive Branch have supported varying positions on such intervention. Prior to the mid-1960's, emphasis had focused on opportunities which were technology driven. From the mid-1960's to the 1970's, more emphasis was given to the idea of how government might promote economic efficiency, i.e., how it might exploit American inventiveness through law.

Beginning in the present decade, (and as the issue of national economic decline became a more dominant political theme), the entire spectrum of "economic competitiveness, revitalization, reindustrialization et al" has emerged as a key concern at the national policy table. A most recent obvious example of this turn of events was reflected in the mid-1980's effort to link improved technological proficiency to restoration of American participation in international trade.

Despite these events, any stable, long-enduring consensus on what is the appropriate role of the government in industrial innovation, technology transfer and U. S. competitiveness has remained elusive. Certainly, part of the problem stems from the inability of the American political-economic system to provide a frame of reference to assess allowable cooperative endeavors between government and industry.

This paper is a discussion of some recent actions aimed at expediting cooperative arrangements among and between government, industry, and academic community. Many believe that common risk-sharing arrangements, involving these three parties, can be fashioned in such a manner as to minimize risk, enhance common purposes and objectives, and meet the growing requirements of the national economic interest.

Experience seems to highlight the importance of the underlying financial dialogue between hopeful cooperative partners as key to successful cooperative arrangements. As a result, subsequent paragraphs deal with such questions as:

- What is a financial dialogue?
- What forces motivate cooperative arrangements?
- In the context of marketplace intervention and competitiveness, what recent legislative actions have been undertaken?
- What Executive Branch actions have been attempted and with what success?
- What other important considerations, e.g., small business involvement, are pertinent?
- How do national and federal laboratories fit into the picture?

The paper will conclude with sections on invoking financial dialogues for cooperative alliances and will note a number of mechanisms available and used as of the end of 1987.

## B. What is A Financial Dialogue?

What is a financial dialogue? It can usefully be defined as a dialogue between two organizational entities focusing on financial mechanisms for achieving desired objectives that are dependent upon cooperation between the two entities.

Familiar examples would be: a government contract to directly fund a contractor to deliver specified products; a bank loan to a company for capital investment; the lease of facilities by one organization to another; the granting of exclusive patent rights; the awarding of export subsidies by a government to protect the domestic market of an industry; and, tax incentives to companies investing in manufacturing improvements. As we have gleaned, financial mechanisms generally take the form of:

- Direct financial instruments, e.g., payments, contracts, etc.
- Financial incentives, e.g., tax breaks, increased fees, etc.
- Indirect financial assistance, e.g., guaranteed buys, import tariffs, etc., and
- Risk-sharing arrangements, e.g., cooperative ventures.

Over the years, an accumulation of statutes, laws, customs and traditions have been built up that represent the collection of constraints on permissible financially-based cooperative mechanisms. These, in turn, reflect public viewpoints over time on marketplace behavior, government-industry relationships, international trade policies, and the like.

At the same time, there is always with us a changing panoply of "in-fashion" or "in-vogue" financial mechanisms reflecting current stresses that most plague government, industry, academe, or the public. Direct funding by government in the form of contracts and grants has always been a favorite with industry. In the 1940's and into the 1950's, GOCOs (Government-Owned, Company-Operated) facilities made possible the rapid, efficient production of tanks and synthetic rubber. In the 1970's, various forms of government financial assistance to companies developing alternative energy sources were popular. The Synthetic Fuel Corporation was proposed and planned for as a cooperative federal-industrial enterprise to provide indirect financial assistance for synthetic fuel production.

The decade of the 1980's has been the breeding ground for a number of cooperative risk-sharing arrangements among industrial participants and between industry and government. The best known instances include the Microelectronics and Computer Corporation (MCC), the industrial R&D Consortium established in 1983, and the industrial Software Productivity Consortium established in 1985.

This paper is a discussion of several of the more popular steps taken to accelerate cooperative arrangements involving government, industry and

university parties. The reasons and the motivations affecting current interest are noted. The concerns of Congress and the Executive Branch are listed and discussed, along with specific legislative actions and executive initiatives taken to these common ends.

C. The Forces Motivating Cooperative Arrangements

There are several primary forces that serve as the apparent genesis for the dramatic increase in cooperative risk-sharing arrangements launched during the 1980's. These forces include:

- Attempts by industry to combat Japanese success in taking away market shares from U. S. industries both in international and domestic markets.
- Attempts by industry to fund high-cost, high-risk, high-tech research and development efforts that could bankrupt a single company trying to "go-it-alone."
- More liberal interpretation of anti-trust laws to permit a greater variety of cooperative arrangements among and between industrial and governmental entities.
- Passage of the R&D Cooperative Act of 1984 and the Technology Transfer Amendment of 1986 that respectively encourage industrial R&D cooperation and facilitate formal, cooperative, business-like ventures between government laboratories and industry.
- The increasing complexity and scope of federal contracts that almost necessitate teaming of contractors in ways closely resembling horizontal and/or vertical integration within an industry.
- The need to find allowable U. S. mechanisms that emulate the success of the Japanese government subsidy of Japanese industry in lowering prices in international markets with accompanying or supporting improvements in quality and productivity.

It will be some time before we understand and can put in context all of the forces that are generating the current movement toward cooperative alliances, and before we can make comparative analyses of what cooperative arrangements are best suited for reducing given types of risk. One message, however, seems clear; namely, that a better understanding of available financial mechanisms will serve to expedite needed cooperative ventures and to obtain the required financial assistance. At the same time, it also seems clear that the least understood feature of any developing cooperative effort is the set of possible financial support vehicles at hand. For these reasons, this paper focuses on the financial dialogue elements so essential to cooperative alliances.

# II. BACKGROUND AND CONTEXT

## A. Rationale for Federal Intervention in the Marketplace

In what is essentially a capitalist economy, such as the United States, innovation for commercial purposes has almost always been viewed as a private-sector activity.

The federal government traditionally has intervened, or become involved in the industrial innovation process, for limited purposes and for a limited period. This type of intervention has, since the beginning of World War II, been aimed at publicly-acceptable objectives with such well-known examples as:

- Speeding up, via government-industry cooperatives called government enterprises, of the development and production of synthetic rubber products to eliminate our foreign dependency during World War II.

- Accelerating the development and introduction of radar into weapons systems during World War II through the transfer of British research and technology to government-industrial laboratory teams.

- Forcing the introduction of numerical tooling into defense production in the early 1950's utilizing the government contract as the "forcing" mechanism.

- Providing a loan guarantee in 1979 to the Chrysler Corporation in which the government assumed the front-end risks that permitted Chrysler to survive and rebuild: here the assumption was that maintaining the automotive industry as then constituted was essential to our industrial competitiveness.

- Establishing with industry, a new industry segment--the space industry--along with a new government funding structure for space R&D and production, i.e., NASA. The purpose of this decade-long effort was to support a national

objective to match Soviet space technology and production exemplified by its Sputnik launch in 1957.

- Formation of the Synthetic Fuel Corporation in 1980 to provide a variety of financial support mechanisms to industry for the development and production of synthetic and alternative energy plants to reduce U. S. dependency on OPEC oil.

- Five-year joint financing from 1986-1991, with the Machine Tool Builders Association (MTBA), of the National Center for Manufacturing Sciences (NCMS) as part of the Administration's effort to restore machine tool production in the United States to world competitive status.

As demonstrated by these examples, the federal government's involvement in business and industry matters has occurred throughout the industrial research, innovation, commercialization and revitalization process. However, the intensity and interactive nature of government intervention generally became less as the supported functions neared the marketplace in the industrial product development process. That is to say, the government has tried to emphasize its financial support of R&D and innovation and to dray away from advanced product development and commercialization.

However, there were, and continue to be, areas where the distinction between government and private-sector responsibilities (or interests) remain unclear. Throughout the decade of the 1980's particularly, numerous questions have surfaced concerning the appropriate role and degree of involvement by government in maintaining industrial competitiveness in both the domestic and international marketplace. And, a wide consensus is emerging that changes in government-industrial-university relationships may be essential to reflect the rapid changes taking place in technology, in manufacturing, and in the restructuring of our domestic industry as a service-dominated economy. Some of the key questions that are being asked are:

- What is the current definition of the intervention and supporting role of government in accelerating and utilizing innovation in developing markets?

- Should the federal government become more broadly involved in the development of new commercial technology, in promoting modernization of manufacturing processes, and in softening the impact of industrial conversion to a service-oriented economy?

- If the federal government is to become involved, what intervention and investment options should be pursued to facilitate technology development: and what is the socially optimum level of investment in innovation processes?

- How best can the federal government make informed decisions concerning investment and intervention in industrial activities?

Most of the recent Congressional legislative proposals incorporating the terminology of competitiveness/technology transfer/innovation/ development have sought to provide operationally effective answers to these illustrative questions, as well as a structural resolution of the problems they reflect. Answers, where they have been provided, have become significant milestones in the quest to articulate a national industrial policy -- a troublesome issue for the nation's lawmakers and industry leaders alike. Some facets of the dilemma, along with corrective actions that have been considered and in some instances taken, are discussed later. An overriding concern stems from the growing sense of national frustration as the international competitive position of the United States continues to erode and as Congress appears more and more unable to address ameliorative industrial policies. It is extremely important to change the perceived ad hoc approach epitomized by current government-industry-university interactions, and to move on to resolve industrial problems before they become national crises.

It is against this backdrop that cooperative alliances between and among the participants -- i.e., industry, government, and university are being undertaken; and it is within this larger context that new specific associations, consortia, institutes, cooperative arrangements et al are appearing.

## B. Current Concerns About Competitiveness

As referenced earlier, there are many motivations behind the current expanding interest in cooperative alliances, involving government, industry and universities. Some of the more obvious, repeated here for context, are the belief that the preeminence of the United States in international industrial competition is seriously threatened, and that the insulation of the domestic markets of the United States from international competition is over. The United States has been slow to accept and adapt to the realities of a highly-competitive global marketplace, and to regard the industrial development of competing countries as a challenge to, as well as an opportunity for, its own economic growth. Consequences of this national failure to adapt are measured in terms of loss of market share, unnecessary plant closings, high unemployment, and noticeable deterioration in the quality of jobs available to American workers. Most observers of this condition have long since concluded that any successful challenge to these problems entails the need for the United States to acknowledge the erosion of the comparative advantage of many of its industries in such important activities as technology, innovation, investment, quality, productivity, and to take the needed corrective actions.

Today, what exists as industrial policy in the United States is a melange of government-funded programs, subsidies, financial support mechanisms, and regulatory oversight functions which cannot be characterized as coordinated, cohesive, or consistent. Improving the competitiveness of United States industries is, in the eyes of the interventionist, a proper and necessary role of government which necessitates cooperative activities with the private sector. When cast in these terms, industry-cooperative efforts take on special meaning.

It is important to note, however, that although the economy may benefit when business, government, university, and public interest groups join forces and work together, there remains no high-level policy forum for developing a consensus or means for resolving national economic issues. There are, instead, a multitude of disparate councils, committees and task forces, all addressing competitiveness problems and the

presumed weakening of U. S. industry. This lack of policy focus seriously endangers the ability of the United States to maintain its defense industrial base which is integral to national security.

Progress towards increased competitiveness, with the concurrent strengthening of our defense industry, depends upon recognizing that the world has moved rapidly toward the creation of an integrated and interdependent economy, and one in which any nation's policies can have a major impact on those of all others. Constructive treatment of world economic problems increasingly dictates the need for multi-national resolutions of many issues, including tax, trade, investment and distribution patterns affecting world markets and world production.

A growing number of members of Congress are showing a preference for more government intervention in protecting domestic industries, promoting exports and in helping bring about structural changes in industry and in industry-government relationships. Their judgement is that in so doing we will be best able to improve our international competitiveness.

During the 99th Congress, for example, proponents of a more active interventionist policy were successful in passing major legislation (but not in overriding a Presidential veto) intended to tackle the competitiveness problem through export credits, promotion of farm exports, trade adjustment assistance, export controls and a number of other related efforts -- all of which were expected to assist in the restoration of American economic influence in increasingly interdependent world marketing efforts. The 99th Congress attempted to deal with the problem through two legislative devices: H.R. 1562, the Textile Act of 1986, which was aimed at the overall competitiveness problem, and which passed both the House and Senate, but was vetoed by President Reagan, and H.R. 4800, the Trade and International Economic Policy Reform Act of 1986, which attacked the overall problem of credits, export policy, trade adjustment assistance, controls and the like. The bill passed the House, but died in the Senate.

The competitive status of U. S. producers continues to be a matter of major concern to U. S. policy makers. Currently, for example, there is debate in the Congress

whether persistent U. S. trade deficits reflect temporary, cyclical economic conditions, or long-term structural problems, such as inadequate productivity growth, and sluggish technological change. Possible government initiatives to improve competitiveness include approaches featuring both sides of the debate, with some aimed at export promotion, trade adjustment assistance, and temporary import relief; while others are intended to initiate structural adjustment, provide assistance in the form of education and training programs, and install some form of incentives for industrial innovation.

## III. RECENT LEGISLATIVE BRANCH ACTIONS IMPACTING COOPERATIVE ALLIANCES

Interest in cooperative alliances and their associated financial requirements has generated a number of legislative proposals. Some of the more significant among them are:

### A. The Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480)

This 1980 Act was passed in order to effect institutional arrangements in support of innovation. American experience, in terms of flagging economic growth and innovation, drew attention to the prospective role of applied technology as a means of providing new products and processes to meet national needs The claim was then being made that the U. S. was the only "competitive industrial nation" lacking an industrial planning organization (something akin to the Japanese MITI), that could foster cooperative arrangements/ relations between and among industry and government. The responsibility for any type of applied research and technology development was quite diffused throughout various institutional units in the federal government. As a result, there was no focus on technology development and application at the federal government level.

Stevenson-Wydler was intended to accomplish four objectives:

- Encourage the creation of organizations within the Executive Branch in order to study and stimulate innovation including the Office of Industrial Technology.
- Promote the innovation and technology development factors through the establishment of Centers for Industrial Technology, funded in part by the federal government.
- Encourage the utilization of federally-funded R&D both in state and local governments, and the private sector.

- Encourage the institution of an exchange program of scientific and technical personnel between universities, industries and federal laboratories.

Experience under Stevenson-Wydler produced less than totally successful efforts in all categories, with some exceptions. In 1986, by amendment to the 1980 law, Congress opened up the area of cooperative research agreements further, doing so by authorizing Government-operated laboratories to enter into such agreements and by establishing a Federal Laboratory Consortium for Technology Transfer within the National Science Foundation. The Consortium idea was modelled somewhat after the earlier Space Act provisions of 1958, which permitted NASA laboratories to enter into cooperative agreements.

Both the 1980 law and the 1986 amendments (the latter known as the Federal Technology Transfer Act (P.L. 99-502) suggest more than ample precedent for cooperative arrangements, though they are essentially government-industry, or government-university arrangements. The idea of industry-industry cooperative undertakings can, however, profit from these earlier attempts to overcome divisive conditions.

An example of a university program stimulated by the Stevenson-Wylder Act and enhanced by the provisions and purposes of the Federal Technology Transfer Act is that of Stanford University where the Japanese are working with the university to license manufacturing rights for patents developed in the university's laboratories. Stanford has an "industrial affiliate" program that has been described as a model for other universities across the country. By its own count, the university has 20 industrial concerns interested in its research programs which range over a spectrum of activity from chemical engineering to manufacturing technology. The university earns approximately $7M annually through this process, and in pursuit of what is seen as a growing market area, has aggressively used the provisions of the Stevenson-Wydler Act in marketing patents to the private sector.

## B. The Federal Technology Transfer Act of 1986 (P. L. 99-502)

This Act sought to clear up a number of misconceptions regarding government-industry-university research relationships.

First, it was intended to make clear that federal laboratories needed authority to do cooperative research and that they needed to be able to exercise that authority at the laboratory level of responsibility. The law permitted the laboratories to enter into cooperative research and development agreements with a wide range of parties.

Second, in addition to making entry into these types of agreement easier, the law sought to protect the legitimate concerns of the government by using precedents set in motion through nearly 30 years of use of the Space Act, which permitted NASA laboratories to enter into such cooperative agreements.

Third, under the 1986 law, laboratories were now permitted to accept funds, personnel, and services, and collaborating parties could accept the same (with the exception of funds) as their contribution under a cooperative agreement.

Finally, one very important provision of the 1986 law concerned the special consideration to be given thereafter to small business and to consortia involving small business. The purpose here was to insure access by these groups to government laboratories. It is important to realize that this provision was not intended to limit access by non-profit organizations and universities, and the Congress was quite specific in this regard.

## C. The National Cooperative Research Act of 1984 (P. L. 98-462)

One other major federal act of importance to the mid-1980's surge in cooperative endeavors was aimed at making necessary and appropriate modifications in the operation of the nation's anti-trust laws. The National Cooperative Research Act of 1984 tackled the difficult problem of adjusting the provisions of the 1914 Clayton

Anti-Trust Act, as it applied to "unfair methods of competition", do so through refinement of the coverage applicable to joint research and development ventures. Heretofore, joint research and development ventures were illegal under Clayton Act provisions. The 1984 Research Cooperative Act revised the terminology of exclusion and made the rule of reasons standard applicable to such activities as the kinds of information exchange permissible, (concerning costs, sales, profitability, prices, etc.) and by specifying that joint research and development ventures would not be deemed illegal per se, but rather would hereafter be judged on the basis of their reasonableness. The importance of these provisions can hardly be overstated. Subsequent to its passage, the Act has stimulated the operation of approximately 200 industry-university consortia.

### D. The Trademark Clarification Act of 1984 (P. L. 98-620)

This law was intended to deal with one of the more thorny problems affecting government-industry-university technology transfer efforts. Specifically, it was designed to handle problems raised as a result of the nation's patent system.

It will be recalled that Article 1, Section 8 of the Constitution simultaneously protects the inventor and fosters competition by stating the Congress has the power to promote science and arts by providing exclusive rights (for a limited time) to inventors and writers as to their works. A 17-year lead time is given the inventor to develop his/her idea, to commercialize it, and to thus realize a return on initial investment. At the same time, the obtaining of a patent places the idea in the public domain, and the disclosure system often stirs others to invent "around" the patent so as to provide parallel developments, or to meet corresponding market needs.

As might be anticipated, ownership of patents stemming from R&D performed under federal funding is an issue with considerable impact on technology transfer from federal laboratories to the private sector. Generally, the government retained title to these inventions and could issue either an exclusive license, or more normally, a non-exclusive license to the

companies involved. A key consideration to resolution of any problem rested on where "title" is held. In most instances, companies were not interested in the pursuit of development applications and marketing, unless some provision could be made regarding their "right to title." The failure of companies to invest time and money in commercialization is still apparent when it is realized that the Congressional Research Service, in a 1987 report on technology transfer, highlighted the fact that only 10% of the ideas patented by the federal government (as a result of federal funding of R&D) are ever used in the private sector.

Important changes in the patent laws were made through enactment of the Trademark Clarification Act of 1984. In a provision with great potential for bringing about increased interaction and cooperation between government-owned/company-operated and private industry in the transfer of technology, Title V of the 1984 law permitted decisions to be made at the laboratory level concerning the award of licenses for laboratory-generated patents. The contractor was to be permitted to receive patent royalties for use in additional R&D, for awards to inventors on his staff, or for their education. A cap on the amount of royalty returning to the laboratory was provided, primarily to prevent distortion of the agency's mission and any congressionally-mandated R&D agenda. The important element, however, was the creation of discretionary funds by which laboratory personnel were given added incentives to encourage and to complete technology transfers.

Another important provision of the Trademark Clarification Act of 1984 to be noted because of its special meaning for small businesses, is the law's permitting of private companies, regardless of size, to obtain exclusive licensing for the full life of the government patent. Prior restrictions allowed exclusivity for only five of the 17 years of the patent. Additionally, the 1985 law removed prohibitions regarding title to federally-funded inventions, but substituting provisions permitting those units operated by universities, non-profit institutions, or small business to retain title (within certain defined limits) to inventions made in their laboratories.

## E. The Defense Industrial Base Modernization Bill of 1988

Among the many bills pending before the current Congress is legislation introduced by Senator Alan Dixon (D-Ill.) intended to strengthen the U. S. defense industrial base and which allows for an impressive array of special contracting authorities to DOD including total or partial set-asides; awarding more than one contract; or sole-source awards; to sustain domestic sources of critical items essential to defense production. The Dixon bill (S. 1892) offers other incentives to attract firms to the defense industry including protection from anti-trust rules for U. S. companies engaged in either R&D or manufacturing related to emerging technologies, or the advancement of manufacturing technologies. At this writing, the Dixon measure was scheduled for Senate hearings in late March, 1988, though the prospects of final passage were uncertain.

## IV. RECENT EXECUTIVE BRANCH ACTIONS

Recent Executive Branch actions are best exemplified by those undertaken through the provisions contained in such laws as the Defense Production Act of 1950; various executive orders such as E. O. 12591, issued in 1987; and, other recent efforts to achieve procurement reform by sharpening the role of DOD as a buyer of goods and services, and as a trainer of key personnel.

### A. The Defense Production Act of 1950

The utility of the DPA, in government-industry-university efforts to forge cooperative plans of attack on "competitiveness" has been unheralded. This 1950 law provides the President with extraordinary authority for assuring the industrial readiness of the U. S. and for keeping national defense programs on schedule and within cost. The Act was passed as a result of a gap in such authority magnified by conditions following U. S. entry into the Korean War. The Act has been extended regularly since 1953. The DPA is, in essence, a Congressional mandate to assure that the U. S. will always have both sufficient resources and the personnel to meet all national defense needs in national emergencies.

The versatility of the DPA is exemplified by a sampling of its usage over the past 25 years:

- By the FAA (in the 1960s) for the national airspace system of air traffic control, communications and navigation
- By the Maritime Administration (in the 1960s) for vessel construction
- By NASA for space vehicles
- By the Atomic Energy Commission for its activities
- By GSA (General Services Administration) in the 1960s for counterinsurgency items

- By the U. S. Coast and Geodetic Survey (in the 1960s) for vessels
- By the Interior Department (during the 1973 oil embargo) for petroleum development and procurement
- By the President (in 1967, 1970, and 1971) for rail transportation needs (during and in strike situations)
- By the Federal Power Commission and the Department of Commerce (in 1974) for construction of the Alaska pipeline

These usage patterns are in addition to amendments made to the Act in 1980, expanding Presidential authority to order the production of synthetic fuels in the amount of 500,000 barrels per day of crude oil equivalent. In the field of energy policy and industry ability to meet daily needs, the 1974 use of the DPA by the FPC and Department of Commerce to accelerate construction of the Alaska pipeline saved the United States, by conservative estimates, at least $500 million in costs plus the added advantage of beginning construction approximately one year ahead of time had the nation been forced to wait upon authorizing legislation.

There are two very significant provisions of the DPA for those contemplating creation of cooperative alliances.

The first is Title III of the Act which provides for the expansion of industrial capacity to meet national security needs. The limits of this authority are constantly changing, and have been used to establish required industrial capacity, for example, where ordinary market mechanisms or stockpiling have proven inadequate. Some of the areas under current review for just such industrial production expansion include high-purity polysilicon, high-purity quartz fiber, polycarbonate, pitch-based carbon fibers, and reclamation of superalloy scrap.

The second is the important provisions in Title VII of the Act which provides authority for representatives of industry and other interests to enter into voluntary agreements serving defense purposes without violating anti-trust agreements.

The prospect of waiver of the traditional obstacles to industrial expansion (and particularly the financing thereof) and of the anti-trust obstacles posed by other national laws suggests a very fertile area of support for potential cooperation alliances involving government, industry and academic interests.

## B. Executive Order 12591 of 1987

On April 10, 1987, President Reagan issued Executive Order (E.O. 12591) calling for vigorous science and technology enterprise involving the private sector..."to keep the United States on the leading edge of international competition." The Executive Order was intended to spell out the steps to be taken by various federal agencies, including NASA, Agriculture, Commerce, Energy, and Health & Human Services through one or more of their laboratories in order to participate in the Technology Share Program -- an effort intended to identify areas of potential importance to long-term national economic competitiveness, and to establish suitable mechanisms by which the U. S. could participate in consortium efforts (with universities and industries) to the end that the necessary edge in international competition be restored and preserved.

The Executive Order also established requirements for the Office of Science and Technology Policy within the Office of the President, to produce a report (by April 10, 1988) listing current technology transfer programs and assessing each; identifying new or creative approaches to such transfer; coming up with criteria by which to assess the effectiveness of such on the nation's economy; and, producing a compilation and assessment of the Technology Share Program and, where appropriate, related cooperative R&D venture programs.

## C. DOD Procurement Reform in 1984

In 1984, DOD announced its intention to undertake fundamental changes in its purchase and spare parts management efforts. Some of the major changes undertaken were:

- Implementation of over 500 spare parts initiatives through their Paperless Ordering Placement Systems (POPS). The system shortcuts order transmission by shipping directly to the user rather than warehousing the item and then transshipping to the user.

- Promotion of competition and the challenging of quoted price by industry.

- Reviewing the systems provision of spare parts sourcing other than by prime contractors.

DOD believed that cost savings and other benefits derived from these steps, such as bringing new suppliers into the systems, have been impressive. The fact remains, however, that these types of change have brought with them new kinds of financial risk for the industrial supplier in the R&D phase as well as in front-end capital investment. A careful reading of the Packard Commission Report of 1986 justified that increased DOD program stability, based on such factors as schedule, quantity, funding level and production rates, required just such a commitment by industry. In return, baselining is being established (cost controls through agreed-upon goals and objectives) along with the adoption of multi-year procurement. Both steps are expected to aid industry in making judgments to compete for government contracting, and if successful, in making cooperative alliances.

## D. DOD as a Buyer and Trainer

No discussion of Executive Branch actions to accelerate the development and use of cooperative alliances would be complete without some view and appreciation of the DOD as a buyer of goods and services in the national economy, and as a trainer of a significant portion of the nation's labor force.

As a buyer, DOD's presence in the rehabilitation of the nation's machine tool industry is a case in point. DOD as a major buyer, directly or indirectly, is a major influence in this industry. Based on the Department's own set of projections, regarding the output of all U. S. industries from 1984 to and through 1990, defense spending accounts for an average of 20% of domestic consumption of metalcutting machine tools, and about 15% of the consumptions connected with metalforming tools. Most of this occurs in the form of direct purchases by DOD. These projections stem from the use of an extremely sophisticated input-output model of the U. S. defense industrial base, known formally as the Defense Economic Impact Modeling System (DEIMS), and while such modeling might be suspect in normal quarters, the fact that a substantial degree of DOD investment of time, money and manpower is directed by the result emerging from such modeling does not, and has not escaped the attention of the professional audience, be it on Wall Street or Capitol Hill.

When one turns to the field of R&D spending, the importance of DOD as a buyer becomes all the more noticeable because R&D is considered a crucial component of long-term industrial and military vitality. The U. S. has traditionally led the world in military R&D spending as a portion of GNP, but in more recent years, according to a 1987 Battelle study, industrialized nations such as Japan and West Germany have outstripped its civilian R&D. However, the significance of this decline is softened when it is realized that many companies remain interested in technology, and have increased their access to it in ways not reflected in R&D spending, such as through licensing, joint ventures, and cooperative agreements.

As a trainer, DOD's own projected demand for skilled workers is a clear indication of the sense of urgency it has lent to the issue of training. The projected demand is shown in Figure IV.1.

These figures have produced some fairly imaginative proposals including requiring defense contractors (over $5 million) to conduct or sponsor training in skills determined to be in short supply. While no action has thus far been taken along these lines, the DOD's desire to increase its own, and hence industries', level of investment in worker skills development is well recognized.

FIGURE IV.1 - PROJECTED DEMAND FOR SKILLED WORKERS BY 1987

| | Defense | | All Industries | |
|---|---|---|---|---|
| | Total | New Workers | Total | New Workers |
| Construction Crafts Workers | 151,450 | 52,580 | 4,384,190 | 618,280 |
| Blacksmiths and Boilermakers | 4,820 | 1,060 | 59,870 | 9,630 |
| Heat Treaters and Annealers | 2,160 | 700 | 20,480 | -50 |
| Forge and Hammer Operators | 1,900 | 720 | 21,950 | 2,020 |
| Job and Die Setters, Metal | 11,620 | 4,860 | 118,090 | 19,790 |
| Machinists and Apprentices | 75,410 | 24,940 | 572,590 | 83,140 |
| Millwrights | 6,460 | 2,240 | 107,870 | 15,420 |
| Molders, Metal & Apprentices | 6,090 | 2,290 | 60,430 | 7,680 |
| Pattern and Model Workers | 4,680 | 1,870 | 38,320 | 4,900 |
| Metal Rollers and Finishers | 1,820 | 720 | 23,980 | 2,780 |
| Sheetmetal Workers & Apprent. | 29,600 | 7,590 | 188,090 | 33,350 |
| Tool & Die Makers & Apprent. | 28,160 | 11,520 | 223,150 | 42,100 |
| Aircraft Mechanics | 60,810 | 16,330 | 159,790 | 30,590 |
| Automobile Mechanics | 38,490 | 10,960 | 1,846,690 | 239,830 |
| Data Processing Machine Repair | 6,780 | 3,370 | 115,880 | 37,520 |
| Heavy Equipment Mechanics | 87,220 | 31,820 | 1,281,720 | 271,020 |
| Machinery & Equip. Mechan.NEC | 78,360 | 18,240 | 1,152,490 | 175,270 |
| Printing Trade Crafts Workers | 15,850 | 2,510 | 410,890 | 9,810 |
| Trans. & Public Utility Workers | 25,670 | 6,700 | 589,640 | 28,590 |
| Crafts & Kindred Workers, NEC | 146,690 | 51,670 | 3,411,990 | 361,740 |
| Drill Press Operatives | 8,860 | 2,150 | 65,140 | 3,410 |
| Furnace Tenders | 6,670 | 2,560 | 82,600 | 8,820 |
| Grinding Machine Operators | 13,240 | 4,520 | 132,240 | 7,610 |
| Heaters, Metal | 600 | 110 | 5,790 | -110 |
| Lathe Milling Machine Operators | 17,970 | 6,250 | 145,800 | 19,400 |
| Metal Platers | 5,830 | 1,890 | 41,220 | 3,450 |
| Other Precision Machine Operators | 10,770 | 3,630 | 88,110 | 14,680 |
| Punch Stamping Press Operators | 18,330 | 7,410 | 193,360 | 25,990 |
| Solders, Welders & Cutters | 81,900 | 24,900 | 889,480 | 153,150 |
| Other Operators, excluding trans. | 620.480 | 232,370 | 10,490,390 | 1,217,280 |
| Transport Operatives | 152,360 | 53,820 | 4,003,490 | 442,730 |
| Construction Workers | 50,760 | 9,970 | 1,007,780 | 56,920 |
| Other Laborers | 166,740 | 38,020 | 3,796,550 | 241,940 |
| Farmers & Farm Workers | 25,130 | 5,890 | 2,534,210 | -160,220 |

*Calculated by subtracting the number of workers needed in 1981 from the number of workers needed in 1987. Figures do not include required worker replacements.

# V. OTHER CONSIDERATIONS IN COOPERATIVE ALLIANCES

## A. The Federal Laboratory Consortium for Technology Transfer

One of the more important federal efforts undertaken to facilitate and coordinate the transfer of technology between various government levels and the private sector is the Federal Laboratory Consortium for Technology Transfer. The Consortium was originally created in 1974, from an ongoing DOD technology transfer program. The 1986 Technology Transfer Act provided the Consortium with a legislative mandate to operate. Significantly, membership by the federal laboratories was to become a requirement, and by mid-1987, representatives from nearly 300 federal laboratories participated.

The basic mission of the group is to promote the effective use of technical knowledge developed within federal departments and agencies by networking the various member laboratories with other federal entities, i.e., state, local and regional governments, and private industry. To accomplish this, the Consortium has established channels through which user needs can be identified, structured, and addressed in light of the increasing demands on non-national government organizations. The Consortium also provides the means by which technologies and expertise for further development and marketing to the public can be made available to the private sector.

The Federal Laboratory Consortium for Technology Transfer is an important addition to the tools available to provide technical and project assistance at the state and local level of government. The intent here has been to furnish technical knowledge and information in such a way that federal sources could be used effectively to solve state and local problems. The Consortium can be accessed through the representative of any member laboratory, the regional coordinator, or by contacting the chairman or executive director. If the requisite technology exists, it is provided free of charge. If modifications are needed, charges may be leveled depending upon the transferring agency's requirements inasmuch as some operate on a cost-reimbursable basis.

The Consortium is expected to remain a networking organization of the federal laboratories and their technology transfer offices. The organization operates as a clearinghouse of information and was established purposely with a small budget and staff in order to perpetuate the volunteer spirit that made the organization a success at the beginning.

## B. Small Business

In terms of responsibility for technological innovation, small business in America has been of critical importance. One National Science Foundation study determined that small firms (i.e., those with up to 1,000 employees) made up 24 times the number of innovations per dollar of R&D expenditure as did large firms with more than 10,000 employees. That is not an insignificant comparison when it is viewed against today's trend of bigness for merger's sake. Over the past 20 years, a number of surveys undertaken in such sectors as steel, aluminum, petroleum and food processing have all concluded that individuals and small firms are of crucial importance to the innovation process. Several years ago (1981) in a series of hearings held on the changes and requirements to be met concerning the revitalization of the American economy, the House Banking Subcommittee on Economic Stabilization documented the importance of small business and of the R&D stemming from its ability to produce successful marriages of business, government and industry interests (hence a large number of the nation's technological changes and innovations). Small business conducts less than 5% of the nation's R&D, yet it is responsible for an incredible level of "innovative change." No better example of this activity exists than the fact that of the top 500 R&D contractors for the DOD, nearly 40% (about 200) are small business firms.

## C. Disadvantaged Business

One other area worthy of note regarding cooperative effort of attack on America's problem of declining industrial competitiveness, concerns government-industry-university efforts undertaken recently to revive and resurrect the nation's machine tool industry.

In an insightful 1985 study, the Manufacturing Studies Board of the National Research Council concluded that for the U. S. machine tool manufacturing industry, and "extended period of world dominance of manufacturing innovation, process engineering, productivity, and market share had ended." The reasons for the industry's decline were manifold: some were due to economic factors; some were attributed to government interference; or the lack of government support.

All such arguments are accepted as legitimate partial explanations of the industry's malaise; the bottomline effect of such self-analysis/appraisal being to stimulate mobilization of academic, industry, and government support of the 1987 establishment of a National Center for Manufacturing Sciences as a crucial first step toward the eventual rehabilitation of the industry. The Center, located in Ann Arbor, Michigan (close to the automotive group), was intended to expand the nation's manufacturing knowledge base and its expeditious dissemination and use by the sponsorship and coordination of various R&D and technology transfer initiatives.

Earlier in 1986, President Reagan had launched a related two-pronged attack on the problem. First, by seeking Voluntary Restraint Agreements (VRAs) on machine tool imports, the President hoped to induce major foreign machine tool producers (Taiwan, West Germany, Japan, and Switzerland) to cut back on their exports to the U. S. or face the prospect of import quotas. Second, the President had directed DOD and the Department of Commerce, in cooperation with other agencies, to implement an action plan to more fully integrate machine tool manufacturers into the defense procurement process. At the same time, the President proposed to provide up to $5 million a year over a three-year period in federal government matching funds, to support the creation of a private-sector technology center to help the industry make advances in manufacturing and design. Those and other steps urged at that time, were intended to insure restoration of the U. S. machine tool industry to its previous "world class" status.

## VI. INVOKING FINANCIAL DIALOGUES FOR COOPERATIVE ALLIANCES

The spectrum of activities on which this paper has concentrated starts with basic research and invention. From that beginning stage, the action moves into development and testing, followed by innovation into product development, then transitions via manufacturing technology and manufacturing processes through the production cycle, and finally enters the marketplace where operational testing and acceptance occurs after acquisition by consumers and users.

This spectrum subsumes a number of highly interactive processes and entities all of which have, in the past, generally been treated as independent of one another with each having its own separate governing bodies of law, regulation, and financial mechanisms. Familiar instances of these entities would include:

1. The research and development cycle
2. The manufacturing process
3. The domestic marketplace, and the foreign marketplace
4. The public sector, and the private sector
5. The production industry
6. The financial industry
7. Public regulation
8. Government financing
9. University research
10. Export and import policies
11. Small vs large business

Cooperation has more often been discouraged than encouraged by law and by tradition. Mismatches frequently exist between allowable financial support mechanisms and required financial needs. Dialogues,

when they occur, tend to highlight misunderstandings and misconceptions of each party's role, rather than the real need to understand and to cope with the changing economy that typifies the single-world marketplace of today, and the highly interdependent financial industry necessary to serve it.

In our examination of the subject, we will simplify this otherwise very complex activity spectrum in order to associate available financial mechanisms with funding needs. It should also be noted that the focus of these comments is on public or government interaction/support of product and manufacturing innovation. Figures VI.1, 2 and 3 list some of the more obvious phases of this Product-Manufacturing-Financial-Support-Spectrum.

Figure VI.4 portrays the three related spectrums of activities associated with:

1. A typical product-innovation process,

2. A typical manufacturing process of the 1980's, and

3. A set of financial support mechanisms involving government involvement that is invoked to assist the two displayed processes.

The phraseology used in Figure VI.4 and the accompanying discussion is not that of the financial analyst, the manufacturing engineer, or the industrial policy specialist. It is instead a vocabulary with which the manager-pragmatist (or the manager as a pragmatist) feels comfortable. It is a set of phrases commonly used in conducting today's financial dialogues between industrial, government, and university managers to describe perceived objectives, problems, issues, and possible resolutions.

The spectrums in Figure VI.4 are intended to serve as templates against which to probe, test, and measure features epitomizing:

- Our economic and technological competitive posture; its perceived deficiencies; and, suggested corrective actions,

- Our old and our new manufacturing processes, which in turn help explain our comparative competitive position in the world market,
- The vigor of our national technological strength and leadership,
- The structure and responsiveness of our defense industrial base,
- The set of available and popular financial mechanisms for supporting our domestic technology innovation and manufacturing base; this serves as the current best indicator of the roles ascribed to government in government-industry interactions, and
- The potential utility of the many currently proposed cooperative arrangements among industrial enterprises and between industry and government.

Two of the more obvious observations to be drawn from the portrayal of what can be labelled the Product-Innovation Manufacturing Financial Support Spectrum are as follows:

- No single financial mechanism is useful in an across-the-board manner for the entire product innovation or manufacturing life cycle, nor, is a single financial mechanism useful across large segments of either spectrum; and
- Financial mechanisms must be custom-fitted to match the life cycle phases in which the problem in question is occurring.

Figure VI.5 illustrates these observations through depiction of some well-documented applications of specific funding mechanisms.

The matrix of activity depicted in Figure VI.6 is intended to provide the reader with the means of assessing those direct and indirect instruments of financial assistance available for stimulating technological innovation. In addition, the matrix

underscores a number of equally pertinent non-economic/non-financial incentives and the risk-sharing arrangements available for today's policymaker regarding the same end purposes.

There are a few essentials that ought to be weighed concerning observations that can be drawn from the matrix presentation. First, the incentives displayed make up the so-called "ground rules" by which policy judgments often will be made, or at least influenced. As might be expected, today's "ground rules" may have less significance in the years ahead, or over that period required for their implementation. World uncertainties, especially those regarding international economic competitive conditions, make this more than an implicit condition of the decision-making process.

Secondly, the circumstances serving as underpinning for the variety of policy options (and for what the technologies involved with each are expected to cover) add up to a broad and extensive listing of disparate incentive options. For example, direct and indirect incentives might suggest the added benefit of regulatory (non-economic) assistance. In the past, it has been a fundamental condition to their successful use, that incentives be matched in a variety of ways to the many differing (sometimes conflicting) approaches to resolving a common problem. Synfuels production, for example, was tackled through adoption of a series of incentives that included government purchase agreements, direct loans, loan guarantees, price supports (floor costs), government installed equipment and facilities, and production goals. In addition, to further enhance the attractiveness of investment in these project areas, completion guarantees were offered whereby the project investor was guaranteed return on investment should any financial difficulty befall the project.

Finally, each incentive, whether it is economic or non-economic, works differently in terms of the specific function with what it deals; the problems it is expected to address; and, the appeal it is assumed to have--particularly to industry. The key to the ultimate use and success of incentives is, therefore, to be found in determination of how much of any type of incentive is really needed. As an example, a consortium might face a number of fundamental barriers to commercialization plus

some institutional obstacles that appear inherent to those circumstances surrounding the establishment of the consortia. Effective incentives to overcome both types of obstacles might include:

- Tax credits,
- Accelerated depreciation, and
- Price guarantees.

On the other hand, large capital exposure to such a consortium effort, (and to any typical company's size as a member) plus the traditional uncertainties associated with regulations might suggest incentives such as:

- Tariffs,
- Loan guarantees, and
- Regulatory relief through the removal of procedural inconsistencies.

The creation of a "level playing field" made up of the appropriate combination of support mechanisms requires infinite patience and imagination on behalf of the initiator.

A number of important policy issues will surface for consideration whenever a financial dialogue is proposed regarding prospective government-industry cooperative efforts. Several of the key issues involved have already been described in earlier portions of this paper. As noted, it is clear that government-industry cooperative policy options rarely can be expected to take identical form in every instance, nor is it probable that their results will be optimized on every occasion. In sum, therefore, difficult choices will have to be made. Some of the major ramifications of such choices are illustrated in Figure VI.6, and have been narrowed down to those expected to accomplish one or all of the following:

- Provision of most economic efficiency
- Provision of greatest breadth of participation

- Provision for least government involvement, and administrative complexity
- Provision for least uncertainty regarding government financial exposure.

FIGURE VI.1 - THE PRODUCT INNOVATION SPECTRUM OF ACTIVITIES

1. Basic Research and/or Invention

   ...Proof of Concept

   ...Theory

   ...Physical Limits

2. Applied Research and Development

   ...Component or Device-oriented

   ...NOT Product Specific

3. Product or System Design (Generic)

4. Prototype Development and Testing

5. Customized (Proprietary) Product Design Development, Test and Engineering

6. Product/System Production

7. Product/System Documentation

   ...Operational

   ...Maintenance, etc.

8. Marketplace Activities

   ...Promotion

   ...Sales

   ...

9. Product/System Maintenance

FIGURE VI.2 - THE MANUFACTURING PROCESS SPECTRUM OF ACTIVITIES

1. Process Design R&D ...e.g., CAD/CAM
2. Environmental, Zoning, etc., Permits & Approvals
3. Capital Investment ... Plants/Facilities
4. Capital Investment ... Equipment
5. Labor/Employment Arrangements
6. Production ... with decisions on
   - ...Rate
   - ...Quality Control
   - ...Productivity
7. Product Documentation
   - ...Technical Data
   - ...Spare Parts
   - ...Quality Control, etc.
8. Marketplace Activities
   - ...Promotion
   - ...Sales
9. Logistics Supply "Train"

FIGURE VI.3 - FINANCIAL SUPPORT MECHANISMS

A. Direct Financial Instruments

1. Contracts
2. Payments
3. Endowments
4. Loans
5. Grants -- Research
   Construction

B. Indirect Financial Assistance

1. Guaranteed Loans
2. Facility and Equipment Leasing (Govt. owned)
3. Patent Ownership and Licensing Rights
4. Trademark Rights and Copyrights
5. Government Furnished Equipment and Facilities, e.g., GO-COs (Government-owned, Company-operated)
6. Technology Transfer
7. Personnel Exchange/Liaison
8. Export Subsidies
9. Import Tariffs
10. Guaranteed Pricing...Price Floors...
11. Voluntary Restraint Agreement (VRA) on Imports

...Sec. 232, Trade Act

FIGURE VI.3 - Financial Support Mechanisms (continued)

C. Risk-sharing Arrangements

1. Cooperative R&D Ventures

...Cooperative R&D Act of 1984

...MCC, Sematech, COS, etc.

2. Guaranteed Loans

3. Guaranteed Buys

4. Cost-sharing

5. Trade Association/Collective Industrial Activities

6. IR&D (USG-funded independent R&D)

D. Financial Incentives

1. Tax Credits (e.g., for R&D)

2. Capital Investment Aids, e.g., Accelerated Depreciation

...ACRS

3. Tax Write-offs, e.g., State/local government incentives for facility location by industry, USG, ...

4. Cost-sharing

5. Completion Guarantees

FIGURE VI.3 - Financial Support Mechanisms (continued)

E. Non-economic Incentives, i.e., Constraint Removal

Regulatory Relief/Reform

...Removal of procedural inconsistencies

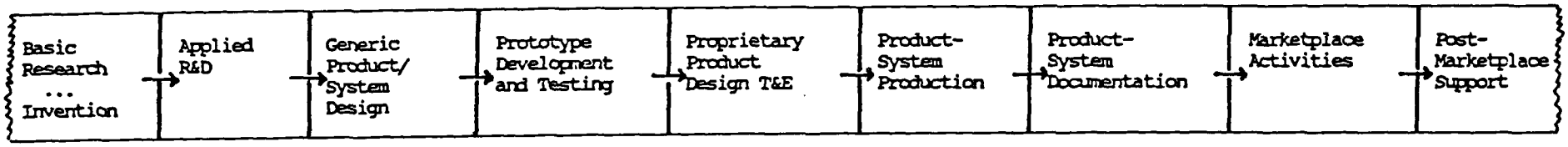
...Reduce conflicts over standards

...Eliminate data duplication

...Minimize impact of future changes

FIGURE VI.4 - THE PRODUCT INNOVATION-MANUFACTURING-FINANCIAL SUPPORT SPECTRUM

A. The Product-Innovation Spectrum




B. The Manufacturing Process Spectrum

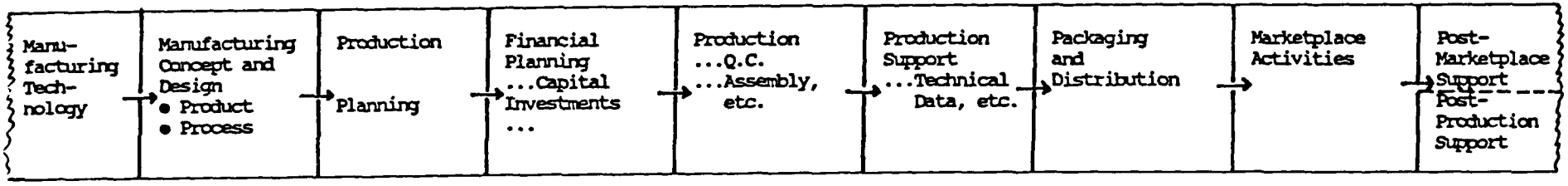


FIGURE VI.4 - THE PRODUCT INNOVATION-MANUFACTURING-FINANCIAL SUPPORT SPECTRUM
(Continued)

C. The Financial Support Spectrum

C.1: For Product Innovation

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Research Contracts /Grants | Endowments | Technology Transfer | Patents Licenses Trademarks Copyrights | Cooperative R&D Ventures | IR&D | Tax Credits for R&D (Incl.tax Write-offs) | Capital Investments Aids | Facilities Construction and/or Lease | Payments | Personnel Exchange/ Liaison |

C.2: For the Manufacturing Process

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Purchase; Pricing; and Completion Loan Guarantees: Loans | Contracts<br><br>Grants - Research and Construction | Facilities and Equipment Leasing and GOCOs | Cost-sharing | Cooperative Production Ventures | Export Subsidies | Cooperative Manufacturing Ventures | Tax Credits, Write-offs, Capital Investment Aids | Patents Licenses Trademarks Copyrights | Regulatory Relief and/or Reforms | Payments |

FIGURE VI.5 - EXAMPLES FROM THE PRODUCT INNOVATION - MANUFACTURING - FINANCIAL SUPPORT SPECTRUM

| Case | Product Innovation Features | Manufacturing Process Features | Type of Financial Mechanism | U.S. Government Involvement |
|---|---|---|---|---|
| 1. Synthetic Rubber Plants - WWII (1942-1947) | • Basic Research<br>• Applied R&D<br>• Generic Product/ System Design<br>• Prototype Development & Testing<br>• Proprietary Product Design Test & Evaluation<br>• Product System Production<br>• Product System Documentation<br>• Marketplace Activities<br>• Post Marketplace Support | • Manufacturing Concept & Design<br>• Production Planning<br>• Financial Planning<br>• Production Quality Control (assembly, etc.)<br>• Production Support (technical data, etc.)<br>• Packaging and Distribution<br>• Marketplace Support | • Industrial Go-Cos (government owned, company operated)<br>• Contracts | • Government furnished equipment and facilities |
| 2. Nuclear Weapons Grade Uranium (Portsmouth - 1955) (Paducah - 1952) | • Proprietary Product Design Test and Evaluation<br>• Product System Production<br>• Product System Documentation<br>• Marketplace Activities | • Manufacturing Concept and Design<br>• Production Planning<br>• Financial Planning<br>• Production Quality Control<br>• Production Support<br>• Packaging and Distribution | • Industrial Go-Cos<br>• Contracts | • Government furnished equipment and facilities |

FIGURE VI.5 - EXAMPLES FROM THE PRODUCT INNOVATION - MANUFACTURING - FINANCIAL SUPPORT SPECTRUM

| Case | Product Innovation Features | Manufacturing Process Features | Type of Financial Mechanism | U.S. Government Involvement |
|---|---|---|---|---|
| 3. Tank Producing Arsenal (Detroit-Lima) (1956) | • Basic Research<br>• Applied R&D<br>• Generic Production Systems Design<br>• Prototype Development and Testing<br>• Proprietary Product Design Test & Evaluation<br>• Product System Production<br>• Product System Documentation<br>• Marketplace Activities<br>• Product Delivery<br>• Post Marketplace Support | • Manufacturing Concept and Design<br>• Production Planning<br>• Financial Planning<br>• Production Quality Control<br>• Production Support (technical data, etc.)<br>• Packaging and Distribution<br>• Marketplace Support | • Industrial Go-Cos<br>• Contracts | • Government furnished equipment and facilities |
| 4. Lockheed Loan Guarantee (1971-1977) | • Marketplace Activities<br>• Post Marketplace Support<br>• Product Delivery | • Production Support (technical data, etc.)<br>• Packaging and Distribution<br>• Marketplace Activities<br>• Post Marketplace Support<br>• Post Production Support | • Guaranteed Loans<br>• Guaranteed Buys<br>• Capital Investment Aids | • Guarantor |

FIGURE VI.5 - EXAMPLES FROM THE PRODUCT INNOVATION - MANUFACTURING - FINANCIAL SUPPORT SPECTRUM

| Case | Product Innovation Features | Manufacturing Process Features | Type of Financial Mechanism | U.S. Government Involvement |
|---|---|---|---|---|
| 5. Alaska Pipeline (1974) | • Product Delivery | • Packaging and Distribution | • Guaranteed Buys<br>• Price Floors<br>• Tax Credits | • Constraint Removal vi "fast track" NEP |
| 6. VHSIC* - (1979)<br>MIMIC* - (1987) | • Basic Research<br>• Applied Research & Development<br>• Generic Product/ System Design<br>• Prototype Development and Testing | • Manufacturing Research and Development<br>• Manufacturing Concept and Design<br>• Production Planning<br>• Production Quality Control | • Contracts<br>• Technology Transfer<br>• Guaranteed Buys | • Contract Source<br>• Guaranteed Customer<br>• Technology Transfer Required |
| 7. Chrysler Loan Guarantee (1979) | • Product System Production<br>• Marketplace Activities<br>• Product Delivery<br>• Most Marketplace Support | • Financial Planning<br>• Production Quality Control<br>• Production Support (technical data, etc.)<br>• Post Marketplace Support<br>• Post Production Support | • Guaranteed Loans<br>• Cooperative R&D Ventures | • Guarantor<br>• Contract Source<br>• Guaranteed Customer<br>• Financial Partner |

*VHSIC = Very High Speed Integrated Circuits
*MIMIC = Monolithic Microwave Integrated Circuits

FIGURE VI.5 - EXAMPLES FROM THE PRODUCT INNOVATION - MANUFACTURING - FINANCIAL SUPPORT SPECTRUM

| Case | Product Innovation Features | Manufacturing Process Features | Type of Financial Mechanism | U.S. Government Involvement |
|---|---|---|---|---|
| 8. "Buy America" (1979) | • Product System Production<br>• Marketplace Activities | • Production Quality Control<br>• Marketplace Activities | • Payments<br>• Import Tariffs | • Payments<br>• Import Tariffs<br>• Trade Adjustmen Assistanc |
| 9. Synthetic Fuels Corporation (1980) | • Basic Research<br>• Applied R&D<br>• Generic Product/ System Design<br>• Prototype Development and Testing<br>• Product System Production<br>• Marketplace Activities | • Manufacturing Concept and Design<br>• Production Planning<br>• Financial Planning<br>• Production Support (technical data, etc.)<br>• Marketplace Activities | • Contracts<br>• Guaranteed Loans<br>• Patent Ownership Licensing Rights<br>• Technology Transfer<br>• Guaranteed Prices<br>• Guaranteed Buys<br>• Completion Guarantees<br>• Constraint Removal | • Contract Source<br>• Guarantee customer<br>• Expeditor<br>• Financial Partner<br>• Technolog Transfer |

FIGURE VI.5 - EXAMPLES FROM THE PRODUCT INNOVATION - MANUFACTURING - FINANCIAL SUPPORT SPECTRUM

| Case | Product Innovation Features | Manufacturing Process Features | Type of Financial Mechanism | U.S. Government Involvement |
|---|---|---|---|---|
| 10. SynFuels R&D (DOE - 1981-82) | • Basic Research<br>• Applied R&D<br>• Generic Product Design/System<br>• Prototype Development and Testing<br>• Proprietary Product Design Test and Evaluation | • Manufacturing R&D<br>• Manufacturing Concept and Design<br>• Production Planning<br>• Production Quality Control<br>• Production Support (technical data, etc.) | • Loans<br>• Grants<br>• Guaranteed Prices<br>• Guaranteed Buys<br>• Personnel Exchange/ Liaison<br>• Cooperative R&D Ventures | • Contract Source<br>• Guaranteed Customer<br>• Technology Transfer<br>• Financial Partner<br>• Cooperativ Ventures |
| 11. National Cooperative Research Act (1984) | • Basic Research<br>• Applied R&D<br>• Generic Product/ System Design<br>• Prototype Development and Testing<br>• Proprietary Product Design T&E<br>• Product System Documentation<br>• Marketplace Activities<br>• Post Marketplace Support | • Manufacturing R&D<br>• Manufacturing Concept and Design<br>• Production Planning<br>• Production Quality Control<br>• Production Support (technical data, etc.)<br>• Marketplace Activities<br>• Post Marketplace Support<br>• Post Production Support | • Endowments<br>• Loans )<br>Grants)<br>• Facility/Equipment Leasing<br>• Patent Ownership/ Licensing Rights<br>• Trademark Rights Copyrights<br>• Technology Transfer<br>• Personnel Exchange Liaison<br>• Cooperative R&D Ventures<br>• IR&D<br>• Cost Sharing | • Government furnished equipment and<br>• Financial Partner<br>• Trade Assoc./ Collective Industrial Activities<br>• Technology Transfer<br>• Constraint Removal i.e., patents/ licensing |

FIGURE VI.5 - EXAMPLES FROM THE PRODUCT INNOVATION - MANUFACTURING - FINANCIAL SUPPORT SPECTRUM

| Case | Product Innovation Features | Manufacturing Process Features | Type of Financial Mechanism | U.S. Government Involvement |
|---|---|---|---|---|
| 12. Microelectronics & Computer Corp. (MCC) (1984) | • Basic Research<br>• Applied R&D<br>• Generic Production/ Design System<br>• Prototype Development and Testing | • Manufacturing R&D<br>• Manufacturing Concept and Design | • Cooperative R&D Ventures<br>• Cost Sharing<br>• Technology Transfer<br>• USG Contract Funds 1988 | • None for 3 years<br>• Contract Funds (1988 |
| 13. Manufacturing Science Technology Center (MTBA) (1986) | • N/A | • Manufacturing R&D | • Voluntary Trade Restraint Agreements<br>• Contracts<br>• Trademark/Licensing Rights<br>• Trade Association/ Collective Industrial Activities | • VRA— Sec. 232 Trade Act<br>• Contracts<br>• Cost Sharing<br>• Trade Assoc./ Collective Industrial Activities |
| 14. Sematech (1987) (Improved manufacturing of large memory chips) | • Prototype Development and Testing | • Manufacturing R&D<br>• Manufacturing Concept and Design<br>• Financial Planning<br>• Production Support (technical data, etc.) | • Cooperative R&D Ventures<br>• Cost Sharing<br>• Technology Transfer | • Financial Partner |
| 15. Semiconductor Manufacturing (1987) | • Product-system Production<br>• Marketplace Activities | • Production Quality Control<br>• Marketplace Activities | • Import Tariffs | • Import Tariffs |

FIGURE VI.5 - EXAMPLES FROM THE PRODUCT INNOVATION - MANUFACTURING - FINANCIAL SUPPORT SPECTRUM

| Case | Product Innovation Features | Manufacturing Process Features | Type of Financial Mechanism | U.S. Government Involvement |
|---|---|---|---|---|
| 16. CAMDEC* (1987) | • Applied R&D<br>• Generic Product/ System Design<br>• Prototype Development and Testing<br>• Proprietary Product Design T&E | • Manufacturing R&D<br>• Manufacturing Concept and Design<br>• Production Planning<br>• Production Quality Control<br>• Production Support (technical data, etc.) | • Payments<br>• Technology Transfer<br>• Personnel Exchange/ Liaison<br>• Patent Ownership Licensing Rights<br>• Trademark Rights<br>• Cooperative R&D Ventures | • Government furnished equipment and facilities |
| 17. NASA - Marshall Space Flight Center GO-CO (Solid Rocket Model Development and Production) 1988—in process | • Basic Research<br>• Applied R&D<br>• Generic Product System Design<br>• Prototype Development and Testing<br>• Prototype System Production<br>• Marketplace Activities | • Manufacturing Concept and Design<br>• Production Planning<br>• Financial Planning<br>• Production Support<br>• Marketplace Activities | • Government-owned, Company-operated<br>• Contracts for products<br>• Patent Ownership Licensing Rights<br>• Technology Transfer<br>• Constraint Removal | • Initiator<br>• Government furnished equipment and facilities<br>• Financial Partner<br>• Technology Transfer<br>• Guaranteed Customer |

*CAMDEC = Ceramics Advanced Manufacturing Development and Engineering Center (Oak Ridge, Tenn.)

FIGURE VI.5 - EXAMPLES FROM THE PRODUCT INNOVATION - MANUFACTURING - FINANCIAL SUPPORT SPECTRUM

| Case | Product Innovation Features | Manufacturing Process Features | Type of Financial Mechanism | U.S. Government Involvement |
|---|---|---|---|---|
| 18. Industrial Space Facility 1988—in process | • Basic Research<br>• Applied R&D<br>• Generic and System Design<br>• Prototype Development and Testing | • Manufacturing R&D<br>• Manufacturing Concept and Design<br>• Production Planning<br>• Production Quality Control | • Industrial Consortium (deep-pocket<br>• USG contracts for development, facilities<br>• Leasing Guarantees<br>• Constraint Removal<br>• Technology Transfer<br>• Licensing Rights | • Contract<br>• Leasing Guarantees USG is "anchored tenant" |

FIGURE VI.6 - JUDGMENTAL ANALYSIS OF EFFECTIVENESS OF FINANCIAL/NON-FINANCIAL POLICY INSTRUMENTS

| Various Financial Non-financial Support Mechanisms | Government Involvement | Return on Government Financial Investment | Participation by Government | Uncertainty with Government Financial Exposure |
|---|---|---|---|---|
| Direct Financial Instruments | | | | |
| • Contracts | Moderate | Moderate | Moderate | Low |
| • Payments | Moderate | N/A | Moderate | Low |
| • Endowments | Low | Low | Low | Low |
| • Loans | High | Moderate | High | Moderate |
| • Grants (Research & Construction) | Moderate | Moderate | High | Low |
| Indirect Financial Assistance | | | | |
| • Loan Guarantees | High | Moderate | High | Moderate |
| • Leasing (Facility Equipment) | High | Moderate | Moderate | Moderate |
| • Patent/Licensing Ownership | Moderate | Moderate | Moderate | Low |
| • Trademark/ Copyrights | Moderate | Moderate | Moderate | Low |
| • GO-COs | High | High | High | Low |
| • Technology Transfer | Moderate | Moderate | Moderate | Moderate |
| • Personnel Exchange | Moderate | Moderate | Moderate | Moderate |
| • Export Subsidy | High | High | High | Low |
| • Import Tariffs | High | High | High | Low |
| • Price Guarantees | High | High | Moderate | Low |
| • VRA (Sec. 222 TA) | High | High | High | Low |

FIGURE VI.6 - JUDGMENTAL ANALYSIS OF EFFECTIVENESS OF FINANCIAL/NON-FINANCIAL POLICY INSTRUMENTS
(Continued)

| Various Financial Non-financial Support Mechanisms | Government Involvement | Return on Government Financial Investment | Participation by Government | Uncertainty with Government Financial Exposure |
|---|---|---|---|---|
| **Risk-sharing Arrangements** | | | | |
| • Cooperative R&D Ventures | Moderate | Moderate | Moderate | Moderate |
| • Guaranteed Loans | High | High | High | Low |
| • Purchase Guarantees | High | High | High | Moderate |
| • Cost-sharing | Moderate | Moderate | Moderate | Moderate |
| • Trade Association Collective Activities | Low | Low | High | Low |
| • IR&D | High | High | High | Low |
| **Other Financial Incentives** | | | | |
| • Tax Credits | High | High | High | Moderate |
| • Capital Investment Aids (i.e., Accelerated Depreciation) | High | High | High | Moderate |
| • Tax Write-offs | High | High | High | Moderate |
| • Cost-sharing | Moderate | Moderate | Moderate | Moderate |
| • Completion Guarantees | High | Moderate | High | Low |
| **Non-economic Incentives** | | | | |
| • Regulatory Relief | Moderate | Moderate | Moderate | Low |
| • Removal of Procedural Inconsistencies | Moderate | Moderate | Moderate | Low |
| • Elimination of Duplicate Data | Moderate | Moderate | Moderate | Moderate |
| • Minimize impact of Future Changes | Moderate | Moderate | Moderate | Moderate |

## VII. SUGGESTIONS FOR ACTION

Given the desire to stimulate a financial dialogue involving elements of government and industry, there are a number of key steps to be considered:

- Are the goals of the dialogue clearly understood and agreed-upon by all parties?
- Given the purpose of any joint industry-government efforts, have the information needs of both audience groups been adequately considered, and will they be adequately provided for and met?
- If the intended dialogue is expected to lead to efforts to promote the diffusion of innovative technology, have all of the relevant parts of the institutional environment been identified and involved (i.e., industry, commerce, finance, education, etc.)?
- Is the technology underlying the joint effort adequately developed, and do both or all parties agree on that item?
- Aside from the financial commitment being sought, are there other aspects of "commitment" needed, and is there sufficient evidence of this prescription?

There are, in addition to these points, a number of other important questions to be asked and answered. Most concern the attributes of the project around which the joint effort may be organized. For example:

- Cost and risk sharing - Will the project come up with the answers?
- Nonfederal project initiatives - Will the project help identify any?
- Existence of a strong industrial system upon which commercialization depends - Does one, in fact, exist? Will the joint project lead to its creation, if one does not exist?

- Inclusion of all elements within the project necessary for commercialization - Will the project aid in such identification and establishment (e.g., capital requirements, tax policy changes, labor supply, etc.)?

There is but one remaining point to bear in mind, regarding stimulation of a financial dialogue involving government and industry, and that is that technology diffusion depends much more on "market pull" than on "technology push." The interests of government and of industry are not always identical, with regard to the implications of "push-pull", so it is important to both parties that these differences be acknowledged, and that the dialogue proceed on the basis of the results of such an assessment. Properly considered, these differences can reduce the pressures to demonstrate immature technologies, and thus they can provide an opportunity for both public policymakers and potential private-sector adopters to deliver an effort within the industrial-government system the financial dialogue was intended to further.