

The DOD-NASA Independent Research and Development Program: Issues and Methodology for an In-Depth Study

Final Report of the

Committee on
Independent Research and
Development Issues

Assembly of Engineering
National Research Council

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purpose of furthering knowledge and of advising the federal government. The Council operates in accordance with general policies determined by the Academy under the authority of its congressional charter of 1863, which establishes the Academy as a private, nonprofit, self-governing membership corporation. The Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine. The National Academy of Engineering and the Institute of Medicine were established in 1964 and 1970, respectively, under the charter of the National Academy of Sciences.

This report represents work under contract number ST0Z20 between the Office of Science and Technology Policy and the National Academy of Sciences.

Available from:

Committee on Independent Research and Development Issues
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Printed in the United States of America

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. Recipient's Accession No. PB02 19274 1												
4. Title and Subtitle The DOD-NASA Independent Research and Development Program: Issues and Methodology for an In-Depth Study			5. Report Date 1981												
7. Author(s) Committee on Independent Research and Development Issues			6.												
9. Performing Organization Name and Address National Research Council Assembly of Engineering Committee on Independent Research and Development Issues 2101 Constitution Ave., NW Washington, D.C. 20418			8. Performing Organization Rept. No.												
12. Sponsoring Organization Name and Address Office of Science and Technology Policy			10. Project/Task/Work Unit No.												
			11. Contract(C) or Grant(G) No. (C) STOZ20 (G)												
			13. Type of Report & Period Covered Final												
15. Supplementary Notes			14.												
16. Abstract (Limit: 200 words) The Department of Defense and the National Aeronautics and Space Administration reimburse contractors, as overhead items, for the expenses of certain independently chosen R&D projects judged relevant to military needs. These "independent R&D" (IR&D) expenses are recognized by the agencies as necessary costs of doing business. The agencies also expect the system of reimbursement to help develop innovative technologies and foster strong and competitive contractor industries. The agencies set a ceiling (by formula or negotiation) on each company's recovery. Bid and proposal costs are also reimbursed, lumped with IR&D costs under a single ceiling for each company. Critics have quarreled with many of the system's features, from accounting procedures to the system's fundamental propriety. The Committee on Independent Research and Development Issues identified and analyzed the issues raised by critics and proponents, compared and interpreted prior studies, and developed guidelines and a methodology for a comprehensive study of the IR&D system; the committee's report contains in addition a detailed history of the IR&D system and a catalog of proposed alternatives to the current system.															
17. Document Analysis a. Descriptors <table border="0"> <tr> <td>Aerospace industry</td> <td>Government procurement</td> <td>National Aeronautics and</td> </tr> <tr> <td>Bid and proposal</td> <td>IR&D Policy Council</td> <td>Space Administration</td> </tr> <tr> <td>Contracting</td> <td>Independent Research and</td> <td>Research and development</td> </tr> <tr> <td>Defense</td> <td>Development</td> <td>U.S. Department of Defense</td> </tr> </table> b. Identifiers/Open-Ended Terms B&P R&D DOD IR&D NASA c. COSATI Field/Group				Aerospace industry	Government procurement	National Aeronautics and	Bid and proposal	IR&D Policy Council	Space Administration	Contracting	Independent Research and	Research and development	Defense	Development	U.S. Department of Defense
Aerospace industry	Government procurement	National Aeronautics and													
Bid and proposal	IR&D Policy Council	Space Administration													
Contracting	Independent Research and	Research and development													
Defense	Development	U.S. Department of Defense													
18. Availability Statement: Approved Public Release		19. Security Class (This Report) Unclassified	21. No. of Pages												
		20. Security Class (This Page) Unclassified	22. Price												

PREFACE

Congressional interest in the Independent Research and Development program of the U.S. Department of Defense and NASA first became apparent in the late 1960s. Since then, some members have continued to raise questions about the program's administration and underlying policy. Most recently, in the Senate Appropriations Committee's report on the federal budget for fiscal year 1979, the Office of Science and Technology Policy (OSTP) was asked to examine the programs.

The Office of Science and Technology Policy decided to divide the requested study into two phases. The first phase was to develop and outline a plan for a comprehensive study of the program, raising issues and proposing research methods without judging the program's merits. The second phase, if required, was envisioned as a comprehensive and detailed assessment, building on the methods proposed and the issues raised in the first phase.

To meet the requirements of the first phase, OSTP accepted a study proposal by the National Research Council's Assembly of Engineering. The Assembly then formed the Committee on IR&D Issues. This committee's statement of task reads as follows:

The Committee will make an assessment of the issues involved for the independent research and development (IR&D) process used by the Department of Defense and the National Aeronautics and Space Administration. The purpose of the examination is to define the elements of an in-depth study and a strategy for conducting it.

In performing this effort, the committee will complete the following tasks:

- Develop a methodology for analyzing the advantages and disadvantages of the IR&D process
- Develop guidelines and procedures that may be used in performing a comprehensive study of IR&D
- Compare and interpret the prior studies, determine areas of consensus and divergence, propose means of narrowing the differences, and define issues for further evaluation.

The committee held three two-day meetings. In the periods between meetings, some members conducted individual studies and interviewed government and industry representatives directly concerned with the IR&D process.

The committee on IR&D Issues is, of course, solely responsible for the content of this report. A number of others, though, have afforded

vital assistance. Study director Joel Goldhar contributed much to the substance of the committee's discussions. Consultants Yale Braunstein and Robert Rich performed valuable analyses of many of the economic issues. Harold Davidson, as consultant to the committee, provided a wealth of historical information and data on the IR&D program's current administration. Staff officer Janice Greene compiled minutes of several meetings and contributed analyses of many of the issues and policy options identified in the course of the study. Duncan Brown, Assembly of Engineering staff officer, served as staff writer and coordinated the report's editing. Editor Rita Byrnes edited much of the text of the report, compiled the bibliography, and drafted most of the material in Appendix A. Finally, the study would have been impossible without the administrative work of staff associate Georgene Menk and administrative assistant Karen Laughlin.

COMMITTEE ON INDEPENDENT RESEARCH AND DEVELOPMENT ISSUES

MARTIN GOLAND (Chairman), President, Southwest Research Institute

SPENCER M. BERESFORD, Chairman of the Board, International Technical Services, Inc.

ROBERT H. CANNON, JR., Chairman, Dept. of Aeronautics and Astronautics, Stanford University

W. DALE COMPTON, Vice President, Research, Ford Motor Company

ROBERT H. ELMAN, Group Vice President, AMCA International Corporation

AARON J. GELLMAN, President, Gellman Research Associates, Inc.

LAWRENCE A. GOLDMUNTZ, President, Economics & Science Planning, Inc.

DONALD GRUNEWALD, President, Mercy College

ELLIOTT B. HARWOOD, Corporate IR&D Manager, The Boeing Company

WILLIS M. HAWKINS, Senior Advisor, Lockheed Aircraft Corporation

ARTHUR I. MENDOLIA, Member, International Advisory Council, William Sword & Company, Inc.

D. BRUCE MERRIFIELD, Vice President of Technology, The Continental Group, Inc.

ROBERT J. POTTER, Senior Vice President and Chief Technical Officer, International Harvester Company

WILLIAM A. RAGAN, Vice President Research and Development, B-D Division, Becton Dickinson Corporation

JUDITH V. REPPY, Senior Research Associate, Peace Studies Program, Cornell University

DAVID Z. ROBINSON, Vice President, Carnegie Corporation

ALVIN M. STEIN, Parker Chapin Flattau & Klimpl

CONTENTS

1	INTRODUCTION	1
2	EVOLUTION OF THE IR&D SYSTEM	6
	The Vinson-Trammell Act and Treasury Decision 5000	6
	The Green Book	6
	Armed Services Procurement Regulations	7
	DOD Instruction 4105.52 and the Negotiation of Advance Agreements.	9
	Technical Evaluation of Contractors' Programs	10
	Difficulties in Allocating Costs to IR&D	10
	The IR&D Study Group	10
	Contractor's Independent Technical Effort (CITE)	12
	Effort to Develop Definitions for IR&D B&P	12
	Determining the Reasonableness of IR&D and B&P Expenses	13
	Congressional Involvement in IR&D and B&P	15
	Changes in Defense Procurement Circular 90	18
	Revisions in Response to Cost Accounting Standard 420	18
	Review of IR&D and B&P Costs for Contractors with DOD Sales of Less than \$50 Million	19
3	CURRENT MANAGEMENT OF THE IR&D PROGRAM	20
	Management Structure	20
	Administration of the Program	21
	Negotiation of Advance Agreements	21
	Ceilings Set by Formula	23

4	MAJOR ISSUES TO BE ADDRESSED	24
	Introduction	24
	Objectives of the IR&D Program	24
	Issues of the Program's Effectiveness in	
	Furthering Its Official Objectives	27
	IR&D as a Stimulus to Innovation	27
	Maintaining Technological Competition Among Suppliers	28
	Enhancing Contractors' Economic Stability	29
	Market Issues	30
	IR&D Funding as a Barrier to Entry into the	
	Defense and Space Markets	30
	Cross-Subsidization	31
	Patent Policy	32
	Accountability and Management	32
5	A SUGGESTED METHODOLOGY FOR A STUDY OF THE ROLE OF IR&D IN DEFENSE AND SPACE SYSTEMS ACQUISITIONS	36
	An Agenda for a Study	36
	A Final Observation	41
	APPENDIX A ALTERNATIVES TO PRESENT METHODS OF IR&D FUNDING	42
	Alternatives That Would Reduce Government Controls	43
	Remove Requirements for Potential Military Relevance,	
	Technical Reviews, and Ceilings	43
	Reimburse IR&D Costs by Increasing Profit Margins	44
	Determine IR&D Allowances by Formula	45
	Fund IR&D on a Multi-Year Basis	47
	Establish Nonprofit IR&D Cost Centers	47
	Fund Some IR&D Projects Through Block Grants,	
	Loans, and Tax Incentives	47
	Alternatives That Would Increase Accountability and	
	Government Control	47
	Allow Government Access to Commercial Records.	48
	Fund IR&D as a Line Item or Under Separate Contracts	48
	Establish Separate Centers for Government R&D.	49
	Separate IR&D from B&P Costs	50

Alternatives Aimed at Enhancing the Value and	
Use of IR&D Results	50
Allow the Government Patent Rights or	
License-Free Use of IR&D Results	50
Evaluate Completed IR&D Projects	51
Quick-Response Mechanism	51
 APPENDIX B ANNOTATED BIBLIOGRAPHY	 52

Chapter 1 INTRODUCTION

This report reviews the issues raised by critics and proponents of the contractor Independent Research and Development (IR&D) program of the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA). These issues should be the foundation of any follow-on full-scale study. This report proposes the outline and approach to such a study, but does not attempt to evaluate the conduct of the program. The committee feels that any future study that follows the outline given here, and carefully considers these issues, will produce insights that will allow better informed political decisions about the program. This committee has attempted to focus primarily on IR&D, but it must be recognized that the more general issues surrounding federal research and development, and defense and space procurement as a whole, provide a context for IR&D decisions that cannot be ignored.

Research and development by U.S. government contractors is either "directed," with the work carefully specified by contract, or "independent." Independent research and development (IR&D) is contractor-initiated, contractor-directed research and development not sponsored by or required in performance of a contract or grant. The independent research and development efforts of companies working for the Department of Defense and NASA include the full spectrum of R&D effort, from basic research to development to system and concept formulation studies.

Under certain conditions, DOD and NASA contractors are reimbursed for the costs of such effort. The IR&D reimbursement system is not a budget line or "program" in the usual sense, though it is often referred to in that manner by DOD and NASA officials. Rather, it is described in the government accounting regulations as a necessary cost of doing business, and thus eligible for reimbursement as part of a firm's overhead on DOD or NASA cost-type contracts.

Any organization involved in extending the frontiers of science and technology must engage in research and development. Support for the R&D efforts of a company working for DOD or NASA can come from any of four sources. First, research and development may be required as essential steps in the design of advanced systems under contract to DOD and NASA. Second, work may be undertaken under DOD or NASA contracts and grants for research and development tasks specified by the agencies as part of their research, development, test and evaluation (RDT&E) programs. Third, the company may perform research and development on its own initiative as

part of its reimbursable IR&D effort. Finally, in firms also marketing commercial products, research and development is undertaken as a way of maintaining or strengthening the companies' market positions. R&D in this last category is funded entirely by the company, and costs are recovered in the prices of products. This purely commercial research and development is of no direct concern to this study and is mentioned only for the sake of completeness in listing a company's R&D funding sources.

In direct analogy to commercial practice, IR&D-type activities, beginning at least as early as 1942, were treated as allowable items of business expense in War Department contract negotiations. The Department of Defense and NASA are heirs to that system. Since 1942, however, a variety of IR&D-related matters, ranging from accounting procedures to the fundamental propriety of government participation in IR&D financing, have been the subject of debate. Chapter 2 outlines the history of this debate.

At present, independent research and development is officially recognized by the Department of Defense, which administers the IR&D program, as "a necessary cost of doing business." Further, by supporting contractors' IR&D work, the government intends, in the words of Department of Defense Instruction 5100.66 (U.S. Department of Defense, 1975), to accomplish the following particular aims:

1. Assure the creation of an environment which encourages development of innovative concepts for Defense systems and equipment which complement and broaden the spectrum of concepts developed internally to DOD.
2. Develop technical competence in two or more contractors who can then respond competitively to any one requirement DOD seeks from Industry.
3. Contribute as appropriate to the economic stability of its contractors by allowing each contractor the technical latitude to develop a broad base of technical products.

Table 1 summarizes financial aspects of the IR&D program as of fiscal year 1979, showing funding by DOD and NASA of various research and development accounts. The table shows that IR&D reimbursements for that year amounted to about 1.5 percent of RD&A funds in both DOD and NASA. Comparing IR&D reimbursements with the DOD total for in-house and out-of-house R&D costs, the ratio is around 5 percent.

Bid and proposal (B&P) costs are also shown in Table 1. A considerable amount of technical study and effort is usually required in preparing high-technology defense and aerospace proposals. Often this effort is identical in nature to what would otherwise be classified as an R&D effort. IR&D and B&P are often discussed together since, as will be noted later, a ceiling on recovery for each contractor sets the maximum dollar amounts which will be accepted as allowable business expenses for the total of both IR&D and B&P costs. Contractors

TABLE 1 R&D-Related Cost Data for DOD and NASA, Fiscal Year 1979

Category of Expenditure	<u>Expenditures, in millions of dollars</u>		
	DOD	NASA	Total
RD&A funds ^a	43,750	3,937	47,687
In-house RDT&E ^b	3,359	369	3,728
Out-of-house RDT&E ^c	9,024	3,238	12,262
IR&D reimbursed ^d	643	54	697
B&P reimbursed ^e	479	43	522

a

RD&A (Research, Development, and Acquisition) funds are the total allocated for all research, development, and acquisition purposes.

b

In-house RDT&E (Research, Development, Test, and Evaluation) refers to the cost for engineer and scientist salaries, fringe benefits and travel, but does not include appropriations for construction of facilities.

c

Out-of-house RDT&E is the cost of all research and development contracted for directly with organizations not part of DOD or NASA (industry, universities, not-for-profits, etc.)

d

IR&D reimbursed relates to the portion of industrial independent research and development costs reimbursed to industry by the government as an element of overhead on DOD and NASA contracts.

e

B&P reimbursed refers to the portion of industrial bid and proposal costs reimbursed by the government as an element of overhead on DOD and NASA contracts.

are given the option of transferring funds from one account to the other so long as the prescribed total is not exceeded. IR&D and B&P are thus different, but related costs.

Figure 1 shows the patterns, from 1969 to 1979, of the total IR&D costs incurred by DOD contractors, the portions of that total accepted by DOD as relevant to its mission and of acceptable quality, and the amount DOD reimbursed contractors as its share of IR&D expenses. The difference between the ceiling amount and the amount actually reimbursed by DOD represents the proportion of relevant IR&D costs that are attributable to non-DOD activities. That is, DOD reimburses each contractor, once a ceiling has been set, in proportion to the fraction of the company's sales accounted for by DOD.

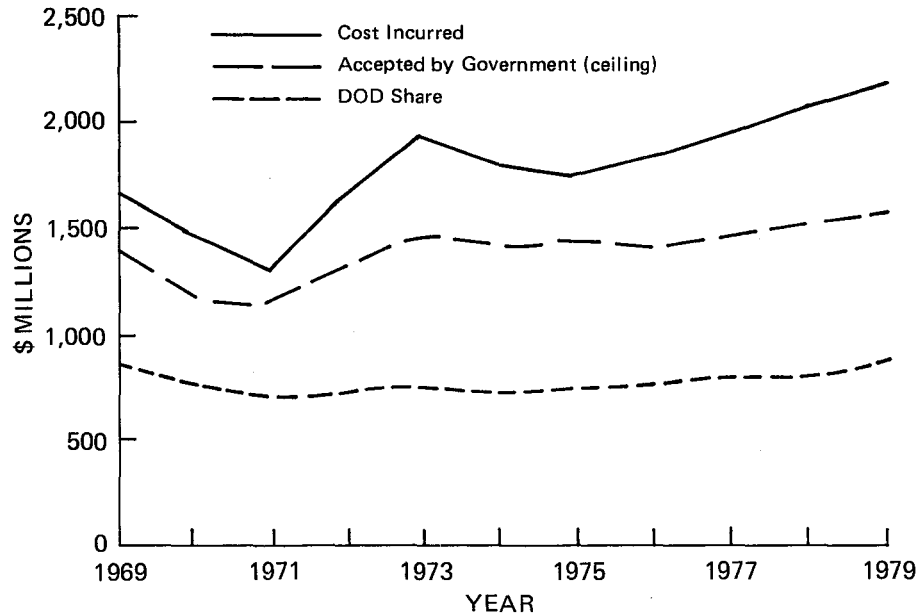


Figure 1 IR&D trends for U.S. Department of Defense contractors, 1969-1979 (Brincefield, 1980)

NASA's dollar participation in the IR&D program is substantially smaller than that of DOD, reflecting the comparatively small size of NASA's total procurement. An examination of NASA data for the period 1975-1979 indicates that IR&D cost allowances increased from \$40 million to \$54 million over the five years, while B&P allowances rose from \$38 million to \$43 million. An examination of the ratio of DOD and NASA reimbursals from 1975 to 1979 indicates that IR&D cost allowances maintained approximately the same ratio as that shown in Table 1.

Chapter 2 of this report summarizes the historical development of the IR&D program, emphasizing changes in management procedures. Chapter 3 summarizes the current official policies and procedures for managing IR&D expenditures.

Chapter 4 outlines and discusses the issues that need to be treated in a comprehensive assessment of the IR&D system. Chapter 5 discusses an approach to gathering the data necessary for the pursuit of conclusions on the utility and effectiveness of the IR&D system.

A review of the many proposed alternatives to the current IR&D program has been left to Appendix A. This is done to suggest that any future study should begin with a review of the appropriateness and utility of IR&D support and an analysis of its effectiveness in furthering its purposes (balanced against any unintended effects). Alternatives to the present system can then be formulated and tested for effectiveness and efficiency in terms of the goals and impacts of the IR&D system.

Chapter 2 EVOLUTION OF THE IR&D SYSTEM

THE VINSON-TRAMMELL ACT AND TREASURY DECISION 5000

The Vinson-Trammell Act, enacted March 27, 1934, included provisions (10 USC 2382 and 10 USC 7300) requiring excess profits on aircraft and shipbuilding contracts to be returned to the U.S. Treasury. Excess profit was defined as "...so much of the profits as the Secretary of the Treasury determines to be greater than 10 percent of the total contract price...." In 1940 the Treasury Department published Treasury Decision (TD) 5000, specifying the expenses to be recognized in determining costs and profits on contracts subject to the Vinson-Trammell Act. Among the allowable expenses were

Indirect engineering expenses, usually termed "engineering overhead," which are treated in this section as part of general expenses in determining the cost of performing a contract or subcontract.

This provision set the precedent for allowing certain engineering expenses, not required by contract, as overhead costs.

THE "GREEN BOOK"

In April of 1942 the U.S. Navy published a new set of cost principles, entitled "Explanation of Principles for Determination of Costs Under Government Contracts" (U.S. War Department, 1942). This document had a green cover and came to be known as the "Green Book"; under the heading "Engineering and Development" was the following:

32. Distinction has previously been made between engineering services related immediately to manufacturing operations (shop engineering expense) and research, experimental and development costs not related to current manufacture but devoted to future improvement in and application of products. The cost of the latter research and experimental development work may be absorbed in manufacturing cost on a regular basis by means of absorption rates, on the principle

that these activities are usually maintained under a consistent program independently and apart from current manufacturing operations, and that their benefit relates to products on a uniform scale over a period of years more properly than according to actual expenditures in any given year. When these costs are deferred or capitalized in conformity with a consistent plan, reasonable allocation may be treated as a cost of performing a contract.

33. Alternatively, when it is the policy to charge off actual research, experimental and development expenses currently in each year rather than to use stabilized absorption rates, a reasonable portion thereof may be allocated to the cost of performing the contract.

The Green Book thus recognized a distinction between engineering expenses related to manufacturing processes and those "devoted to future improvement in and application of products" (i.e., IR&D expenses). Separate cost principles for these two categories of cost continue to exist to this day. The Green Book generally followed the policies set forth in TD 5000, and became the principal cost guide for such contracts.

ARMED SERVICES PROCUREMENT REGULATIONS

The Department of Defense did not publish a set of cost principles for mandatory use by all DOD components until the March 1949 edition of the Armed Services Procurement Regulations (ASPR), Section XV of which included "...standards for the determination and allowance of costs in connection with the performance of cost-reimbursement type contracts." Before this, TD 5000 and the Green Book served merely as guidelines.

In addition to tests of reasonableness and allocability, ASPR Section XV gave specific examples of allowable and unallowable costs. Among the items of allowable cost (paragraph 15-204(s)) was "research and development specifically applicable to the supplies or services covered by the contract...." Paragraph 15-205(j), "Examples of Items of Unallowable Costs," barred recovery of expenses for "general research, unless specifically provided for elsewhere in the contract."

Although the ASPR cost principles provided a single DOD policy for cost allowance, these two cost principles relating to IR&D were not specific enough to ensure consistent interpretation. Some contracting officers concluded that only R&D necessary to satisfy a contract was allowable under paragraph 15-204(s). Others held that any R&D broadly related to contract work was allowable, so that, for example, R&D aimed at improving aircraft engines could be allowed on engine production contracts.

Paragraph 15-205(j) was also subject to varying interpretations. Some assumed that "general research" included all research and development. Others believed that since the word "development" was not used,

only projects classified as research were to be disallowed, with development costs allowable under paragraph 15-204(s).

Since the language of 15-205(j) allowed the cost of general research when specifically provided for by contract, many contractors insisted on such provisions. The Air Force reacted by requiring contractors to submit annual IR&D plans for review. An agreement was then negotiated with each contractor, specifying the IR&D costs to be allowed on Air Force contracts. This was the forerunner of the present procedure of negotiating advance agreements with major contractors. (See Chapter 3.)

In the early 1950s, DOD came under pressure to develop a more precise and detailed set of cost principles. Adoption of such principles was advocated by the House Appropriations Committee, the Comptroller General of the United States, and the Hoover Commission. Work on new policy language continued for several years, and a completely revised ASPR Section XV was published on November 2, 1959.

At the time, growing concern that the Soviet Union was challenging U.S. technological preeminence had produced a general feeling that IR&D should be encouraged. However, many at DOD favored constraints to ensure that such effort would produce useful results and that costs would be controlled. Government proposals included requirements that contractors burden their IR&D expenses with overhead costs, share IR&D expenses equally with the government, restrict allocation of IR&D costs to production contracts, negotiate advance agreements for the recovery of IR&D in some instances, and allocate certain IR&D costs only to contracts related to the same product lines.

Industry, on the other hand, urged that the government avoid controls that would unduly hamper contractors' research and development flexibility and prevent recovery of all reasonable costs. They proposed recovery of all IR&D costs meeting the ASPR's general rules for reasonableness.

In the adopted version of the cost principle, overhead burdening was not made mandatory, and only development costs (as distinguished from research costs) were required to be allocated on a product-line basis. Implied, but not clearly stated, was a requirement that if the contractor had no production work, development costs could be allocated to research and development contracts provided they were allocated by fields of R&D effort.

Also included was a provision that, for contractors whose business was substantially with the government, the use of advance agreements should be considered. For these contractors cost sharing was suggested, and three methods were proposed for determining how to allocate costs to DOD contracts:

1. Acceptance of allocable costs of selected projects, with non-government work benefiting from the projects paying its allocable share. (The manner of selecting projects was not clearly defined.)
2. Establishment for each contractor of a flat dollar ceiling on IR&D expenses, an allocable share of which would be charged to DOD contracts.

3. Acceptance of an allocable share of a percentage of all IR&D costs, so that a percentage of each dollar spent could be put into a cost pool and allocated equitably to all the contractor's work.

DOD INSTRUCTION 4105.52 AND THE NEGOTIATION OF ADVANCE AGREEMENTS

Concurrently with the publication of the new IR&D cost principle, Department of Defense Instruction (DODI) 4105.52, dated June 28, 1960, was developed to implement the principle's provision on the negotiation of advance agreements. It established the Armed Service Research Specialists Committee to review contractors' IR&D programs for technical quality and to determine that research and development projects had been properly segregated. The Military Departments were required to designate a sponsoring Department for each contractor whose IR&D costs were substantial, whose business was largely with DOD, and who had contracts with more than one Military Department. Accordingly, the three Military Departments established a list of contractors whose annual IR&D costs were \$1 million or more and half or more of whose business was with DOD.

DODI 4105.52 also required these contractors to submit annual technical brochures describing proposed IR&D projects, and to provide cost estimates. It further required the sponsoring Military Department for each contractor to conduct negotiations with the contractor, inviting other Departments to participate. The results of the negotiations were to be binding on all Departments. In cases in which agreements could not be negotiated before the beginning of the contractor's fiscal year, review and negotiation were to be accomplished after costs were incurred.

The Departments published implementing guidance in their procurement policy documents, the Army Procurement Procedure (now the Army Defense Acquisition Regulation (DAR) Supplement), the Navy Procurement Directives (now the Navy Contracting Directives), and the Air Force Procurement Instruction (now the Air Force DAR Supplement).

At the beginning of 1960, each Military Department had its own central office, responsible for negotiating overhead rates on cost-type contracts with most major defense contractors. NASA also participated and used the negotiated rates. Although no formal charter or procedural policies existed, the three departmental offices cooperated closely and had become known as the Tri-Service Negotiation Offices. Their procedures were convenient means of negotiating advance IR&D agreements, and they were therefore assigned this responsibility under DODI 4105.52.

As noted earlier in the discussion of IR&D cost principles in the Armed Services Procurement Regulations, section XV, paragraph 15-205, three approaches were proposed for setting limits on IR&D in negotiating advance agreements. The first of these, allowance of specified projects, was seldom used, because it tended to frustrate the objective of flexibility in IR&D efforts. The second and third approaches, establishment of a dollar ceiling and acceptance of an allocable share of all IR&D costs, were combined in almost all advance agreement negotiations. These agreements recognized a percentage of all of a contractor's IR&D

expenditures, ranging from about 50 to 75 percent, subject to a specified dollar ceiling. Contractors who did not burden IR&D costs with overhead costs usually received 50-percent rates; others could usually expect 75-percent rates.

Such advance agreements allowed each contractor to accumulate a percentage of each IR&D dollar spent in an indirect cost pool until the costs accumulated reached the dollar ceiling established. These costs were then allocated to all customers' contracts, including DOD and NASA contracts, on a common basis of allocation. The difference between the percentage rate allowed and the amount spent (e.g., 25 percent if the contractor had a 75-percent rate) was absorbed by the contractor. If the contractor's actual expenditures exceeded the dollar ceiling (e.g., \$1 million to reach a \$750,000 ceiling at a 75-percent rate), he was required in addition to absorb all the excess. Most contractors spent more than enough to reach their ceilings.

TECHNICAL EVALUATION OF CONTRACTORS' PROGRAMS

The Armed Services Research Specialists Committee was established by DODI 4105.52 to perform technical evaluations of contractors' proposed IR&D programs, on the basis of technical and cost data submitted for each project. As an aid in establishing limits on allowability, contractors were required also to provide projections of sales for the year and the percentages of sales represented by DOD and NASA business. Data on past years was also required, to indicate trends.

DIFFICULTIES IN ALLOCATING COSTS TO IR&D

Implementation of the IR&D cost principles soon brought several problems to light. The first ASPR case on IR&D was opened in September 1960 to consider the need for clarifying whether independent development should be allocated only to production work or also to research contracts. A second problem in this case was whether the allocation of independent research to "all work" included an allocation to independent development. In March 1961, a second ASPR case reopened the question of allocating overhead to IR&D, which had been discussed at length before the cost principle was written. A third case, established in August 1961, addressed the practical problem of clearly defining product lines, as necessitated by the ASPR requirement that independent development costs be allocated on a product-line basis.

THE IR&D STUDY GROUP

The complexities of the problems being raised delayed any final resolution of these cases and led to the formation of the IR&D Study Group in the Office of the Secretary of Defense in September 1962. The group was to review the problem of IR&D reimbursement thoroughly and propose

policy changes to alleviate difficulties.

The IR&D Study Group issued its report in November 1962. Among the report's findings were the following:

1. Government negotiators were requiring both cost sharing and a ceiling, thus imposing a double limitation. Furthermore, cost sharing was being required without a finding of unreasonableness.
2. In the rare cases in which government negotiators were using the option of allowing or disallowing the costs of specific projects, scientific freedom was being unduly restricted.
3. The DOD negotiation team did not include a technical representative, and contractors were not consistently informed of technical evaluation results.
4. Technical evaluation:
 - Too much emphasis was placed on contractor's technical brochures as primary means of evaluating contractors' programs.
 - Only Navy evaluators were making plant visits.
 - Evaluation reports were not completed soon enough and were inadequate.
 - One benefit of the evaluation program was that contractors were required to be explicit about their technical planning, which resulted in improved IR&D management in some companies.
 - Technical evaluators were required to spend too much time trying to distinguish between research and development, inherently indistinct categories.
5. Allocation:
 - IR&D-type costs were appearing under such other account titles as bid and proposal, which at the time was not subject to limitation.
 - The rigid allocation procedures in the IR&D cost principle frequently did not fit the circumstances, especially with respect to decentralized corporations and in cases in which product lines were not clearly definable.

The Study Group proposed changing the IR&D cost principle to incorporate all technical effort in IR&D unless sponsored by a contract or grant. Full overhead and general and administrative (G&A) costs were to be

allocated, and all cost sharing was to be eliminated, except that a dollar limitation or ceiling was to be imposed. The military services, NASA, and the Atomic Energy Commission raised numerous questions and objections to the proposed new policy, and DOD established a task group in the middle of 1963 to work out the problems. This group was replaced in late 1963 by a new steering group in the higher management levels of Research and Engineering and Procurement Policy in the Office of the Secretary of Defense.

CONTRACTORS' INDEPENDENT TECHNICAL EFFORT (CITE)

In early 1964 the acronym CITE, for "Contractors' Independent Technical Effort," was coined to replace IR&D and B&P. Efforts were made to develop a comprehensive definition for CITE, and a study was begun to find a simple formula approach for determining reasonableness. The CITE effort drew more and more attention, including that of the Bureau of the Budget. At the Bureau's request, DOD requested comments from NASA, the Atomic Energy Commission, the Office of Science and Technology, the National Science Foundation, and industry groups. The diverse views of these parties increased the difficulty of developing an acceptable policy, and no revisions of the existing IR&D policy were published until 1970.

Industry comments on the CITE concept indicated concern about lumping all unsponsored technical effort under the heading. Some individuals in DOD were also concerned; lumping these costs together, they thought, would substantially reduce the visibility of costs incurred by contractors, thus reducing the ability of DOD contracting officers to determine whether the costs were reasonable and allocable to defense contracts. The question was eventually elevated to the Secretary of Defense in October 1966, resulting in a decision by the Secretary that the CITE concept should be abandoned and that separate cost principles should be prepared for IR&D and for bid and proposal (B&P) costs.

EFFORT TO DEVELOP DEFINITIONS FOR IR&D AND B&P

One of the more perplexing problems associated with IR&D was its close relationship to B&P effort and other types of technical work included in overhead accounts. To help develop definitions for IR&D and B&P that would clearly separate these costs from each other and from other miscellaneous costs, the Defense Contract Audit Agency (DCAA) was asked to review the accounting records of major defense contractors.

In early 1967 DCAA produced a report covering contractors' fiscal years 1963 through 1966, showing contractors' total costs in these categories, the sales over which the costs were spread, and the amounts applicable to DOD contracts. Reports have been prepared for each year since, and now provide the basis for an annual report that DOD is required to furnish members of Congress.

A special effort was put into the review of the "other technical effort" (OTE) category (work not clearly belonging in either IR&D or B&P

categories), and this item was disaggregated in a separate report for several years. This study was intended mainly to discover what types of technical or engineering costs, other than those classified as IR&D or B&P, were being incurred. The purpose was to obtain samples of the types of costs, to help in drafting definitions for IR&D and B&P that would include all costs properly belonging in those two categories. The OTE report was discontinued after several years, when it was judged to have served its purpose.

DETERMINING THE REASONABLENESS OF IR&D AND B&P EXPENSES

From May 1964 until October 1966, while the CITE concept was under consideration, a major effort was made to find a simpler, more efficient way to determine the reasonableness of IR&D and B&P costs. The process of negotiating advance agreements was costly to contractors and DOD.

One approach that was investigated was the use of "industry norms." It was thought that a study could determine the relative amounts spent by various segments of industry (electronics, airframes, shipbuilding, etc.) on IR&D and B&P, and that these averages or norms could serve as measures of allowable costs. For example, the IR&D costs of an electronics company beyond those corresponding to the industry norm would be considered excessive. A questionnaire sent out to industry produced information that displayed very little consistency. Some of the more technology-dependent companies spent considerable sums; others, whose business did not require the latest technology, spent very little.

Although the industry norm concept was found unsatisfactory, efforts to find a simple formula for determining the reasonableness of IR&D and B&P expenses continued. One proposal was to use each company's historical expenditure data to compute an average that would set the ceiling. The data for major defense contractors furnished in the report for the years 1963 through 1966 were used, and a variety of formulas was tested.

The work done on developing a formula and definitions for IR&D and B&P made it possible to develop new draft cost principles for the two types of cost shortly after the CITE concept was struck down by the Secretary of Defense. The first drafts, circulated within DOD in January 1967, included the following features:

- Contractors with approved contractors weighted average share in cost risk (CWAS) ratings (Appendix A, p. 45) would not be questioned as to the reasonableness of IR&D costs.
- Each contractor without CWAS approval who incurred over \$1 million in IR&D costs would be required to negotiate an advance agreement to establish the next year's dollar ceiling or be limited to \$1 million as a ceiling.
- Contractors incurring less than \$1 million in IR&D costs would be subject to a formula-derived dollar ceiling, based on past expenditures.

- Contractors would not be required to share IR&D costs below the ceilings.
- B&P costs incurred prior to a contractor's receipt of a request for proposal were to be treated as IR&D costs.
- Contractors required to negotiate advance agreements for IR&D were required also to negotiate advance agreements for B&P. IR&D ceilings could be exceeded by the contractor to the extent that B&P costs were reduced by the same amount, and vice versa.
- B&P costs incurred after receipt of a solicitation by a contractor not required to negotiate an advance agreement would be subject only to the general rules of reasonableness set out in the Armed Services Procurement Regulation (now the Defense Acquisition Regulation.)

After consultation with the Military Departments, other DOD components, and NASA, the draft cost principles were agreed to. Drafts were sent to industry and other government agencies for review and comment in late January 1968.

The formula proposed in the January 1968 drafts for contractors without advance agreements was substantially the same as that now used. Under the present formula, the previous three years' IR&D and B&P costs are related by ratios to sales (or another acceptable base) for the same years. The two highest ratios of IR&D and B&P costs to sales are averaged, and the resulting ratio is applied to the current year's sales (or other base) to establish the dollar ceiling.

In a second step the costs incurred for each of the past three years are determined and the two highest are averaged. The resulting figure is multiplied by 120 percent to determine the absolute dollar ceiling limit. The ratio computation serves as the ceiling on allowable expenses so long as it does not exceed the 120 percent limit. A minimum ceiling is established by multiplying the dollar average by 80 percent. If the ratio computation produces a number below the 80-percent figure, the 80-percent computation governs. The only difference between the current formula and that in the January 1968 draft is that the January 1968 draft had a maximum limit of 110 percent, instead of 120 percent.

The January 1968 draft cost principles provided that B&P costs incurred after receipt of a request for proposal were to be allowed without a ceiling limitation, but subject to the general rules of reasonableness under the Armed Services Procurement Regulation (ASPR), now known as the Defense Acquisition Regulation (DAR). B&P costs incurred before receipt of a request for proposal were to be treated as IR&D costs.

Industry comments on the January 1968 draft, received in June, leveled numerous criticisms at the formula, the advance agreement negotiation requirements, and other aspects of the proposed principles. The Assistant Secretaries of Defense for Installations and Logistics and

for Research and Development met on November 5, 1968, to consider these matters. Following this meeting three issues remained unresolved:

- Which of several formulas should be used?
- Should the formula be applied to all contractors, or should advance agreement negotiations continue to be used for major defense contractors?
- Should contractors be required to apply overhead costs to IR&D and B&P, or should they be permitted to continue deciding this for themselves?

On December 6, 1968, these issues were submitted to the Deputy Secretary of Defense for a decision, with the following result:

- Advance agreements were to be abandoned, and all contractors were to be subject to the formula in the current DAR. An appeals procedure was to be established for use by contractors or contracting officers unsatisfied with results of the formula.
- All contractors were to be required to apply overhead costs to IR&D and B&P costs.

CONGRESSIONAL INVOLVEMENT IN IR&D AND B&P

The decisions of the Deputy Secretary cleared the way for again drafting revised cost principles, which were circulated to industry and other agencies in February 1969. However, before the new cost principles could be promulgated, Congress became involved. In August 1969 Senator William Proxmire introduced amendment 123 to the fiscal year 1970 Military Procurement Authorization Act. The amendment would have forbidden the use of funds authorized under the Act for IR&D, B&P, or other technical effort (OTE, a miscellaneous category of technical costs treated as overhead), except for work specifically authorized by contract or determined by the contracting agency to be of direct or indirect benefit to a specific defense contract.

The amendment was replaced in the final Authorization Act (Public Law 91-121) by a provision in section 403 requiring DOD to limit reimbursal of IR&D, B&P, and OTE costs to "...93 per centum of the total amount contemplated for use for such purposes out of funds authorized for procurement and for research, development, test, and evaluation...." Fixed-price contracts awarded on the basis of price competition and negotiated contracts for amounts under \$100,000 were exempted. Only funds appropriated for fiscal year 1970 were restricted, but since most contractors had many contracts funded by appropriations from various years, implementation of the Act required sifting through contracts one by one to determine which were affected; the amounts of IR&D, B&P, and OTE cost allocable to each; and the amount of allocable cost that would

have been allowed by an advance agreement or other negotiated settlement.

Senator Proxmire in October 1969 introduced Senate Bill 3003. This bill provided that IR&D costs would be allowable on negotiated contracts only if specifically provided for by contract and of direct or indirect benefit to the work being done under contract. Bid and proposal costs on such contracts would be restricted to 1 percent of the direct charges.

Senator John Stennis, Chairman of the Senate Committee on Armed Services, asked the Department of Defense for its views on S. 3003. The Department responded on February 13, 1970, with a letter detailing many objections, summarized in the following paragraph:

The Department of Defense thus considers the restrictions proposed by S. 3003 on reimbursement of independent research and development costs and bid and proposal costs not to be in the best interest of successful and efficient defense procurement. We believe S. 3003 would tend to inhibit the development of new technology, is not fully in accord with recognized accounting practices, would be administratively impracticable, would unfairly prevent some contractors from recovering reasonable costs and could lead to a lessening of competition, thus potentially increasing the overall cost of the defense effort. Therefore the Department of Defense is opposed to the enactment of S. 3003.

Senator Stennis advised the Secretary of Defense that hearings on S. 3003 would be conducted by the Ad Hoc Subcommittee on Research and Development beginning on March 2, 1970. Coincident with the Senate action on IR&D and B&P, the Armed Services Investigating Subcommittee of the House Armed Services Committee announced that a subcommittee on IR&D would begin hearings on March 25, 1970. John Foster, the Director of Defense Research and Engineering, represented DOD at both hearings.

As the hearings approached, DOD reviewed its proposed IR&D and B&P policies in light of the criticisms by Senator Proxmire and others, notably the General Accounting Office (Comptroller General, 1970). It was concluded that a policy more rigid than the use of a formula for all contractors would be required. Five recommendations were approved as the basis for the DOD position to be proposed during the hearings. They were as follows:

1. Major defense contractors would be required to submit their IR&D programs to DOD for technical review. Separate ceilings for IR&D and B&P costs would be negotiated in advance agreements. IR&D and B&P ceilings would be interchangeable provided the sum of the two was not exceeded. Application of overhead to IR&D and B&P would be required. If an advance agreement were not negotiated, cost recovery would be substantially reduced.
2. All contractors other than major defense contractors would be subject to the formula.

3. The technical review of contractors' IR&D programs would be strengthened and supplemented by periodic on-site reviews. Also, a data bank on IR&D programs would be established.
4. Military Departments would formally recognize the need to increase technical review and include items in their annual budgets to support the costs.
5. The Department of Defense would continue its policy of not acquiring rights to technical data and patents arising from IR&D programs.

In testimony before the two subcommittees, this program was presented in the formal statement of the Director, Defense Research and Engineering. The statement also stated that legislation on IR&D and B&P was unnecessary under the plan DOD was prepared to implement.

In reports issued after the hearings the House accepted most of the DOD five-point plan and opposed any legislation. The Senate Subcommittee, on the other hand, recommended legislation but rejected S. 3003. The House and Senate positions disagreeing, the issue was referred to a House and Senate Conference committee, with the following results, embodied in the Military Procurement Authorization Act for Fiscal Year 1971 (Public Law 91-441), enacted in October 1971:

- Contractors incurring annual IR&D and B&P costs in excess of \$2 million would be required to negotiate advance agreements for the following year.
- Technical evaluations of the IR&D portions of contractors' programs would be required.
- Projects, to be allowed, would be required to have, "...in the opinion of the Secretary of Defense, a potential relationship to a military function or operation."
- Contractors who failed to conclude advance agreement negotiations would be reimbursed at substantially less cost than would otherwise have been allowed.
- The Department of Defense would be required to report annually to the Congress on IR&D costs and negotiations.
- Section 403 of the Fiscal Year 1970 Military Procurement Authorization Act, which limited IR&D, B&P, and OTE payments to 93 percent of "the total contemplated for use for such purposes," would be repealed.

This legislation has remained unchanged except for the recovery thresholds for negotiating advance agreements, which were raised in the 1981 Authorization Act from \$2 million to \$4 million, to account for inflation.

The new legislation became effective in January 1971, allowing limited time to prepare implementing regulations. An interim regulation was prepared and published in Defense Procurement Circular 84, dated November 30, 1970. The circular was limited to guidance in implementing the legislation and did not otherwise revise the existing cost principles. Final cost principles were published in Defense Procurement Circular 90, dated September 1, 1971. The effective date for the new cost principles was set for the contractors' first fiscal years beginning on or after January 1, 1971. Since the requirements necessitated significant changes in the practices of certain companies, contracting officers were authorized to extend the applicability date to no later than the contractors' first fiscal years beginning after June 30, 1972.

CHANGES IN DEFENSE PROCUREMENT CIRCULAR 90

Since the publication of Circular 90, the IR&D and B&P policies of DOD have not changed except for the thresholds determining which contractors must negotiate advance agreements. Since 1970, when the legislation was written, the effect of inflation has doubled R&D costs. Accordingly, DOD proposed to the Congress in early 1980 that the figure be raised from \$2 million to \$4 million in IR&D and B&P reimbursals, and that provision be made for revising the threshold in future years.

This proposal was included in Section 208 of Public Law 96-342, the Defense Procurement Authorization Act for Fiscal Year 1981. This legislation also raised the threshold for negotiation with individual divisions of a company from \$250,000 to \$500,000, and instructed the Secretary of Defense to adjust the dollar thresholds every three years beginning on October 1, 1983, based on economic indices he selects. These higher thresholds took effect on October 1, 1980.

REVISIONS IN RESPONSE TO COST ACCOUNTING STANDARD 420

The Defense Acquisition Regulation Section XV Part 2 Subcommittee in DOD is revising IR&D and B&P cost principles to bring them into accord with Cost Accounting Standard (CAS) 420. Standard 420 generally prescribes the same procedures as those in the Defense Acquisition Regulation (DAR). Most of the required changes in the DAR involve adopting the standard's definitions and allocation requirements to avoid the confusion that might occur if the standard's language varied from that of the cost principles.

In particular, there are certain differences between Standard 420 and the DAR as to the method of handling IR&D work performed by one segment of a company for another. The standard, but not the DAR, requires that this work be treated as contractual work, burdened with indirect costs, and transferred to the requesting segment. The standard is also more specific in requiring the costs of IR&D and B&P benefiting more than one segment of a company to be transferred to the home office for allocation to all benefiting segments. A third difference is the

requirement that IR&D and B&P costs be allocated to final cost objectives (contracts) on the same basis as general and administrative costs. The extent to which contracts not covered by the standard will be exempted is yet to be determined.

REVIEW OF IR&D AND B&P COSTS FOR CONTRACTORS WITH DOD SALES OF LESS THAN \$50 MILLION

In March 1979, the Deputy Under Secretary of Defense for Acquisition Policy asked the Defense Contract Audit Agency (DCAA) to review the IR&D and B&P costs of a sample of contractors having DOD sales under \$50 million. The purpose was to assess the effects of the formula used for setting ceilings on recovery. (See Chapter 3.) Records on 61 companies were reviewed; data on those whose total IR&D and B&P costs exceeded 7 percent of sales were further examined to determine their ratios of government sales to commercial sales. Of these, only four had more than 29 percent government sales. In each of the four the formula limited recovery of IR&D and B&P costs.

This review led DOD to question the need for the formula. In the case of companies having 30 percent or less government business, competition in the commercial marketplace seemed adequate to ensure that IR&D and B&P costs were kept within prudent limits. All four of the others had more than 75 percent government sales.

If this sample is truly representative, only a few companies with DOD sales under \$50 million have IR&D and B&P costs that warrant close review. Use of the formula for these companies provides no assurance that the costs it allows are appropriate. The formula-based allowance may be too liberal or too restrictive. For example, a rapidly growing, small high-technology company with a growing IR&D budget may be unduly penalized by the practice of basing recovery on past years' sales and IR&D expenses.

In October 1979, DOD advised representatives of the Office of Federal Procurement Policy (OFPP) that it proposed to eliminate the formula and substitute a simple requirement for review of contractors' costs, when appropriate, to determine reasonableness. OFPP representatives opposed this change pending receipt and review of industry and agency comments on proposed language that had been drafted for the new Federal Acquisition Regulation. DOD has taken no further action on this issue.

Chapter 3 CURRENT MANAGEMENT OF THE IR&D PROGRAM

It is clear from Chapter 2 that management of the IR&D program has undergone a lengthy evolution. During the early years, when the principle of cost-reimbursement for IR&D was being established, government contract negotiators had little in the way of formal guidance in establishing acceptable overhead rates for cost-reimbursable contracts with industry. What has finally evolved is a structure for management and administration of IR&D that enables negotiators to continue to exercise some measure of judgment, but which provides them with formal procedures as a base for decisionmaking.

The purpose of this chapter is to describe the current management and administrative structure used by DOD in connection with IR&D activities. As already noted, NASA follows DOD IR&D procedures and also contributes to the program's management and administration to the extent justified by its relatively small financial involvement in IR&D cost-reimbursement.

MANAGEMENT STRUCTURE

Department of Defense Instruction 5100.66 (U.S. Department of Defense, 1975) sets forth DOD's IR&D management structure. It establishes an IR&D Policy Council to provide recommendations on policy on a continuing basis. Members include the Undersecretary of Defense for Research and Engineering (as Chairman); the Assistant Secretaries of Defense (Comptroller, Manpower, Reserve Affairs, and Installations and Logistics); and the military services' Assistant Secretaries for Research and Development and for Installations and Logistics. A NASA representative participates as an observer.

The Undersecretary of Defense for Research and Engineering is also responsible for the IR&D Technical Evaluation Group, which coordinates technical evaluation activities and implements Policy Council decisions. This group includes the departmental IR&D managers from the Military Departments and a chairman appointed by the Undersecretary for Research and Engineering. The current members are from the Army Material Development and Readiness Command, Headquarters, the Air Force Systems Command, and the Office of Naval Research. The chairman of the Technical Evaluation Group, who also serves as Secretary to the Policy Council, is the

Assistant for Research in the Office of the Deputy Undersecretary of Defense for Research and Engineering (Research and Advanced Technology). According to DOD Instruction 5100.66 the Technical Evaluation Group is responsible for establishing uniform criteria and methods for evaluations and ratings, debriefings of contractors, technical plan format, conduct of on-site technical reviews, provision of evaluation results to negotiators, and the content and format of an IR&D Data Bank operated by the Defense Technical Information Center for the information of DOD and NASA technical personnel.

ADMINISTRATION OF THE PROGRAM

As explained earlier in this report, IR&D and B&P expenses are recoverable by contractors as overhead items on cost-reimbursement contracts with the Department of Defense and NASA, subject to several restrictions on allowability. The primary criterion for allowability is a "potential relationship...to a military function or operation," according to section 15-205.35 of the Defense Acquisition Regulation, which specifies procedures for use in determining IR&D reimbursements. Each contractor's reimbursement is limited by a ceiling on allowable expenses, and below this ceiling the government reimburses expenses on a pro rata basis according to the proportion of the company's business accounted for by DOD and NASA. Any recipient of more than \$4 million in IR&D or B&P reimbursements in any fiscal year must negotiate an advance agreement on the allowability of the next year's planned IR&D program. Smaller contractors are reimbursed under ceilings set by formula, according to previous years' sales and IR&D activity. The negotiation procedure and the formula are described later in this chapter.

Contractors do not simply recover their allowable independent R&D expenses up to the limit set by the ceiling. First of all, because such expenses are reimbursed as overhead items on cost-type contracts, a contractor's total cost recovery will be in direct proportion to his volume of sales to DOD and NASA during the year, at least until the ceiling is reached. Second, only that proportion of the allowable costs corresponding to the percentage of the firm's business accounted for by DOD and NASA is reimbursed; the remainder must be recovered from the proceeds of other sales. In theory, all of the DOD and NASA components that are responsible for technical evaluations and negotiations of IR&D recovery use equivalent standards and procedures. However, each has its own implementing regulations, and in the past the military services have differed on such principles as the restrictions on funding work connected with the fulfillment of commercial contracts (Comptroller General, 1974b).

Negotiation of Advance Agreements

Companies required to negotiate advance agreements for recovery of IR&D and B&P expenses begin by submitting for review technical plans detailing the individual projects they intend to pursue. The Department of Defense,

in preparing for negotiations, evaluates these plans for technical adequacy, staff and management proficiency, and potential military relevance. Aside from the relevance and program reasonableness requirements, the evaluation does not include any opinions regarding the specific directions and goals of the R&D projects. These are contractor prerogatives.

The evaluation is coordinated by the IR&D Technical Evaluation Group, which assigns the plans to different "lead services" (the appropriate components of the military services, the Department of Defense, and NASA) for evaluation. The lead service organizations assign evaluators with the technical expertise necessary for assessing each individual project. Evaluators score the individual projects on a standard DOD form (DD-1855), arriving at numerical ratings of technical quality. The completed evaluation forms are sent back to the designated lead service organizations for preparation of reports covering the overall company plans. As one step in the evaluation process, scores of the individual projects are combined by a dollar-weighted formula to provide scores for the complete plans. Comments by the evaluators are taken from the forms and listed by project number so they may be provided to the company without specific identification of the scores. Evaluation summaries, evaluator comments, and executive summaries, along with determinations of potential military relevance, make up the technical evaluation reports, which are provided to the lead service IR&D managers.

The IR&D managers review and approve the technical evaluation reports and forward them to the negotiators for use in determining the ceiling by advance agreement.

While negotiators use a variety of background data to guide their final decisions as to levels of cost reimbursement, the technical evaluation reports are intended to be a significant input. Based on the extent of program competence displayed in these reports, negotiators are empowered to increase IR&D reimbursements by up to 20 percent, or to decrease them by a like amount, from levels that might otherwise prevail.

To obtain consistent determinations of potential military relevance, the reviewers apply the following criteria to the projects: Is DOD precluded, by law or otherwise, from funding such R&D? Is the military requirement for the end product urgent, routine, or nonexistent? Will the application of the end product be primarily military, primarily nonmilitary but with substantial military application, or only incidentally military? Is DOD, rather than another government agency, responsible for this field of R&D? The lead service for each company's plan reviews and identifies those projects that do not appear to have potential relevance to military functions or operations. A project is adjudged relevant if it is determined to be so by any one of the services. The final list of projects found to lack potential military relevance is provided to the cognizant negotiator, who ensures that reimbursement is not made for those projects. If there is too little in the project description for a determination, if a reasonable doubt exists, or if a project is a separable mix of relevant and irrelevant tasks, the contractor may be required to provide additional information or to separate combined tasks for further consideration.

Technical plans are reviewed every year. Recently, DOD added triennial on-site reviews to provide a means of confirming the yearly technical plan evaluations and to encourage face-to-face dialogue between DOD and industry technical personnel. The on-site reviews cover at least 30 percent of the dollar amount of each company's program, and often more. Such reviews usually include some discussion of the individual company's management procedures for selecting projects, the character of internal progress reviews, and the place of IR&D projects in the long-range business objectives of the organization. Reports of on-site reviews are prepared and furnished to the tri-service negotiators as supplements to the technical plan evaluations.

Information gathered during the technical plan reviews is also entered into an IR&D Data Bank, which contains the title of each project and a brief summary of the work to be accomplished. DOD and NASA personnel have access to the Data Bank, but it is not available to non-government personnel. The Data Bank is intended to make government technical personnel aware of current IR&D work, minimizing duplication of effort by government and industry (in cases where such duplication is considered undesirable). The information can also be used (discreetly and within the bounds set by the confidential nature of individual company plans) to reduce unnecessary duplication of effort by contractors.

Ceilings Set by Formula

For recipients of less than \$4 million in IR&D and B&P funds (who form the majority of recipients), a formula is used, in place of the technical review and negotiated advance agreements, to set each year's ceiling on recovery.

In computing ceilings under the formula, a company's recovery of IR&D and B&P costs in each of the last three years is related by a ratio to the company's sales in the same years. The two highest of the resulting ratios of recovery to sales are then averaged, and the average ratio is applied to the current year's sales (or another acceptable base) to establish a dollar ceiling on recovery. In a separate step, the IR&D and B&P expenses incurred in the two highest of the previous three years are averaged and multiplied by 120 percent. The result, if lower than the figure arrived at by the ratio computation, serves as the ceiling on the current year's recovery. (A floor is set by multiplying the dollar average by 80 percent; if the limit set by the ratio computation is less than this value, the 80-percent figure serves as the ceiling on recovery.)

Chapter 4 MAJOR ISSUES TO BE ADDRESSED

INTRODUCTION

This chapter enumerates and discusses the issues that should be addressed in a comprehensive assessment of the IR&D program. A review of the program's objectives, as seen by various observers and participants, is an obvious place to start. The listing of issues in this report thus begins with an examination of the officially stated objectives, their validity and appropriateness, and some of their ramifications. Issues relating to the program's effectiveness in practice are then raised.

But beyond questions of the program's objectives and its effectiveness in furthering them lie broader questions with which any further study should deal. Some concern the nature of the objectives themselves, in the context of the general economy and the peculiar circumstances of the defense and space markets. Others have to do with the degrees of accountability and control that should be imposed on the system.

This chapter does not discuss, except in passing, any of the many proposed alternatives to the current IR&D system. Some of the issues that this chapter raises may lead to one or another of such options, but in the interest of clarity and balance, we have placed the discussion of alternatives suggested by various commentators in Appendix A. Any further study should look beyond the options described there; a systematic and comprehensive study of the IR&D program may develop further options.

OBJECTIVES OF THE IR&D PROGRAM

Department of Defense Instruction 5100.66 (U.S. Department of Defense, 1975) is the official statement of policy for the administration of IR&D funding. It states that "IR&D/B&P is recognized by the DOD as a necessary cost of doing business." The implication is that the government, like any other customer, should pay a price reflecting the total costs of doing business over the long term and that these costs include research and development undertaken at company discretion. This idea dates back at least to the Navy's 1942 "Explanation of Principles for Determination of Costs Under Government Contracts" (U.S. War Department, 1942), which allowed the costs of contractors' "research, experimental and development costs not related to current manufacture but devoted to future improvement in and application of products" to be reimbursed

"as a cost of performing a contract."

Over the years this fundamental principle has been challenged. Some, for example, argue that the government pays directly for all the RDT&E costs of products it intends to procure, and assert that IR&D in that sense need not be considered a normal cost of doing business for military and space contractors (U.S. Congress, Senate, 1975, pp. 687ff). Others stress the special features of the defense and space markets (one dominant buyer, relatively small exposure to the risk of unsuccessful development, etc.) as support for this contention. (U.S. Congress, Senate, 1975, pp. 703ff).

Obviously, if the IR&D program were generally recognized as reimbursement of necessary business expenses, little additional justification would be needed. However, the history of the IR&D program prompted DOD to clarify the goals and purposes of IR&D activities. As cited in DOD Instruction 5100.66 (U.S. Department of Defense, 1975), they are as follows:

Through support, consistent with the cost principles established in [the Armed Services Procurement Regulation], of contractor's IR&D/B&P programs, DOD seeks to:

1. Assure the creation of an environment which encourages development of innovative concepts for Defense systems and equipment which complement and broaden the spectrum of concepts developed internally to DOD.
2. Develop technical competence in two or more contractors who can then respond competitively to any one requirement DOD seeks from industry.
3. Contribute as appropriate to the economic stability of its contractors by allowing each contractor the technical latitude to develop a broad base of technical products.

This section will, for the time being, assume that these objectives are the criteria against which the program's operation and its results must be measured. However, the fundamental rationale for IR&D funding (the recovery of necessary R&D expenses) is an issue with which any future study must deal.

The first of the cited objectives highlights the primary purpose of the program from the government's standpoint. That purpose is to help provide a reservoir of creative ideas, developed at company initiative. The deliberately loose technical control of IR&D work by the Department of Defense, it is claimed, allows contractors to work on defense-related problems with a minimum of agency direction and procurement delays. The intended result is an environment especially conducive to innovation,*

*For discussions of the environment for creative research and development, see Dean and Goldhar, 1980; Pelz and Andrews, 1976; Steiner, 1965; and Twiss, 1974.

yielding new contributions to the technology base and novel systems approaches, in addition to those chosen for contract RDT&E funding.

The second objective, often abbreviated as "competition," is related to the first; it is expected that encouraging independent approaches to military problems will in the end put more than one contractor in the technical position to bid on a given request for proposal (RFP). This is expected to yield to the Department of Defense some of the benefits of market competition.

The third objective, providing "economic stability" to contractors, represents an attempt to allow contractors to maintain their technical strengths in the face of the special vicissitudes of the defense and NASA procurement markets, in which contract funding may be very unpredictable and uneven from year to year. The aim is to provide, by means of IR&D funding, opportunities for contractors to strengthen, broaden, and diversify their expertise and thus their potential markets. The benefit to the government is expected to be a strong, reliable, and stable industry.

In the past these goals have been discussed by Congress, DOD, the aerospace industry, and others, and attempts have been made to clarify the program objectives. Among the benefits cited for IR&D by various sources are the following:

- Encouraging relatively long-term R&D work, as distinguished from projects directed at responding to RFPs in the near future (Tri-Association Ad Hoc Committee, 1974a, p. 14; Soergel, 1975).
- Maintaining a stable level of R&D funding by DOD/NASA in areas critical to the national interest.
- Acting to smooth fluctuations in R&D employment and stabilize firms' R&D programs by enabling contractors to maintain staffs of talented technical specialists as contract demand for their services varies from time to time.
- Encouraging the spin-off of defense and related technologies into areas such as mass transit, medical instrumentation, and laser communication (Tri-Association Ad Hoc Committee, p. 19, 1974c).

Any in-depth study of the IR&D program should consider whether these additional objectives, as variously interpreted, are desirable and whether they are efficiently attainable. It should also examine whether the actions of the participants imply other objectives for the program. Arriving at answers to such questions will require a comprehensive and detailed knowledge of how the program works in practice.

ISSUES OF THE PROGRAM'S EFFECTIVENESS IN FURTHERING ITS OFFICIAL OBJECTIVES

A number of general questions can be raised with the IR&D program's officially cited objectives as background. How much does the IR&D system broaden "the spectrum of concepts" available to DOD, and what is the value and the cost of this innovation? To what extent does the system promote competition in bidding? To what extent are IR&D funds used to strengthen and diversify firms' technical bases? These three questions, corresponding to the three objectives cited in DOD Instruction 5100.66, are questions about the program's effectiveness in the narrow context of its goals. The section of this chapter entitled "Market Issues" considers the IR&D system in the broader context of the defense and space market and the surrounding commercial economy. The section "Accountability and Management" raises questions about administrative procedure and accountability, framing its discussion in terms of the issues discussed in this section.

IR&D as a Stimulus to Innovation

Stimulus to innovation is the primary objective of the IR&D program, according to DODI 5100.66. It is asserted that more R&D will result in more innovative proposals in response to RFPs, and that funding independent, contractor-controlled R&D adds in unique ways to the potential for innovation, beyond the level possible with only directed RDT&E support. The special "independent" nature of IR&D work is said to yield high returns on the government's investment. There is disagreement, however, about the extent to which these returns complement those on ordinary contracted RDT&E funds.

Critics (DGS Associates, Inc., 1976; Paine and Adams, 1980; Reppy, 1976; Reppy and Long, 1976; Soergel, 1975) contend that, in practice, funds are often used on relatively short-term projects, to the detriment of longer term contributions to the technology base. Among the forces acting to bias the work in this way may be government program managers' indirect influence, emphasizing nearer term objectives.* Another bias may be the normal industrial sales incentives, which favor the pursuit of expected near-term contracts over work in more speculative fields. These may tend to decrease the strength of the more fundamental technology-base contributions of the program. However, the Department of Defense and many in industry do not consider the distribution of IR&D work between longer and shorter term goals to be an important issue (U.S. Congress, Senate, 1975, p. 290), and the current official policy documents leave

*Program managers should not be confused with IR&D technical evaluators. The former are managers of ongoing projects and may suggest IR&D directions which enhance their project goals. IR&D technical evaluators are not permitted to influence the choice of IR&D projects except to the extent already noted in Chapter 3.

the question of balance up to the discretion of the contractor.

Many critics in industry assert that the negotiation of IR&D and bid and proposal (B&P) allowances under a single ceiling hampers innovation in years when contract funding is low. In such periods, contractors have strong incentives to divert IR&D funds to their B&P accounts, in search of contracts. The result is a bias toward the applied end of the R&D scale and away from the more speculative work that forms some component of IR&D. The remedy generally suggested (see, for example, Tri-Association Ad Hoc Committee, 1974a, p. 13) is separation of the two categories and allowance of all bid and proposal costs as overhead, with no ceiling. Bethel (1975, pp. 93-95), however, discusses the likelihood of "IR&D-type" expenses' migrating into ceilingless B&P accounts in such a case.

The following specific questions need to be answered in evaluating the impact of IR&D on defense and space system innovation:

1. Is there a legitimate role for IR&D as an adjunct to the contract RDT&E program? Do the two complement one another in cost-effective ways to yield better defense and space products and systems?
2. To what extent has IR&D funding been responsible for significant innovations in defense/space systems? If the answer is positive, can it be validated by a suitable number of case histories?
3. What are the civilian analogs to IR&D and how do they work? How does the innovation process work in defense and space contractors? How similar is it to our understanding of the process in the civilian sector?
4. What is the balance between long-term and short-term work in the R&D being supported by IR&D? Is this an important issue?
5. To what extent does B&P drive out IR&D effort during low contract funding years due to the firms' ability to switch IR&D funds to B&P accounts under a common ceiling?

Maintaining Technological Competition Among Suppliers

The second official objective of the program is to foster technological competition among bidders. A competitive market structure for defense and space systems is a keystone of our procurement system. The relatively low negotiated profits (on the basis of sales) typical of monopsony markets such as those in aerospace or military ordinance, and the special capabilities required of high-technology contractors, tend to restrict competition to relatively limited groups of companies. This is especially true when competitive strategies require large investments in activities with distant and uncertain outcomes.

The IR&D system's role in increasing competition in the defense

market depends on its ability to induce "two or more contractors" (in the words of DODI 5100.66) to develop the technical background to bid competitively on a given contract. The object is to maintain, in each area of interest, several contractors in positions to respond quickly and competitively to government requests for proposals. By this means, DOD and NASA hope to gain some of the benefits of market competition.

On the other hand, the possibility of anticompetitive effects is obvious; by protecting those already serving as DOD or NASA suppliers, the system may erect a barrier to entry by potential competitors.

The key questions this issue raises are as follows:

1. To what extent does IR&D funding promote technological competition in bidding?
2. How valuable is this technological competition in maintaining an economically competitive contracting environment and delivering innovative and technologically advanced systems?
3. Does the IR&D system act as an incentive or as a barrier to the entry of new firms into the defense and space market?
4. How do IR&D availability or IR&D results enter into firms' decisions to respond to specific requests for proposals?
5. What criteria do firms use in choosing projects to support with IR&D funds?

Enhancing Contractors' Economic Stability

The flow of contract funds to a typical DOD or NASA contractor can fluctuate widely for reasons completely outside the control of the firm. The SST and B1 programs are classic examples. Through the IR&D funding system, the government expects to smooth the flow somewhat, by helping contractors diversify "to develop a broad base of technical products," according to DODI 5100.66. This not only furthers the previously discussed objective of encouraging redundant efforts in the name of competitive bids, but may also enable a company to submit a successful unsolicited proposal or develop products for other markets (Gamota, 1980a, 1980b). The ultimate benefit to the government is a more stable and therefore more reliable pool of technical talent among potential contractors.

If, in fact, the purpose of IR&D funding were only to maintain contractors' financial stability, the possible anticompetitive effect would be a serious concern. However, the other objectives, building technological strength and producing innovative solutions to problems, may work in the opposite direction, enhancing both competition and stability.

The stability issue is an important one. There is considerable

evidence, from studies of R&D productivity and innovation in civilian organizations (Dean and Goldhar, 1980; Pelz and Andrews, 1976) that continuity and certainty are more important to the efficiency and effectiveness of R&D than the absolute level of financial support. Whether this is true in the context of defense and space acquisition, with its large contract RDT&E component, needs to be examined.

The more important questions raised by the issue are as follows:

1. To what extent does the IR&D system encourage firms to enter or leave the defense and space markets?
2. Has IR&D funding been significant in helping firms to solidify their positions in the market or develop new product lines consistent with their expectations about the future of the defense and space market? Have IR&D funds helped companies diversify outside the DOD and NASA markets?
3. To what extent does IR&D, based on the prior year's sales, act as a "flywheel" to lessen the impacts of fluctuations in RDT&E funding?
4. Does the availability of IR&D funding significantly influence the level of corporate funds allocated to R&D? How does this differ as a function of the proportions of government and civilian business in each firm?

MARKET ISSUES

IR&D Funding as a Barrier to Entry Into the Defense and Space Markets

The IR&D program provides funds to existing DOD and NASA contractors for research projects they have undertaken. This funding mechanism may discriminate against noncontractors so as to erect a barrier to entry into this market.

The costs of R&D are written off against current sales revenues, but the financial returns occur after (sometimes long after) the costs are incurred. A firm desiring entry into a new market (e.g., the defense and space market) may need to make substantial investments in R&D to achieve a competitive posture in a high-technology commercial market.

There is a difference, however, in the mode of independent R&D financing between defense and NASA contractors and noncontractors. In the case of the latter, such funds are entirely internally generated, and they tend to rise in high-profit years and fall when profits are low. Defense and space contractors, on the other hand, are assured of receiving pro-rata shares of IR&D funding from the government, based on sales volumes and not net profits. This provides contractors with a somewhat more secure flow of R&D funds than is available to potential

new entrants into the field.

This stabilizing effect has been cited as a barrier to the maintenance of a competitive environment, and its significance should be assessed.

A number of questions can be asked:

1. What advantages in obtaining contracts does the IR&D system yield to contractors but withhold from noncontractors?
2. Do these advantages, if any, represent barriers to entry by noncontractors? If so, how do they compare with other barriers to entry in this and other markets, both commercial and government?
3. How could the anticompetitive effects, if any, be ameliorated without unduly compromising the presumed benefits of the program?

Cross-Subsidization

The formula for reimbursing contractors for IR&D expenses, once the ceiling limit has been established, is based on a pro-rata sharing of the total costs on the basis of the relative proportion of the contractor's sales to DOD and NASA as compared to sales in other market sectors (commercial products, other governmental sales, etc.). Arguments have been raised that this method of allocation may be unfair to the government in some instances, and to contractors in others. Whether this is true will depend on the composition of the overall IR&D program in a particular year, and the impact of IR&D results on the spectrum of new or improved products that enter the market.

Some critics (Reppy, 1976, pp. 35ff; U. S. Congress, Senate, 1975, pp. 687ff) contend that the IR&D program can subsidize contractors' commercial business. IR&D funds, they say, can be used to support commercial innovation; while meeting the requirement of potential military relevance, elements of the program can have fairly direct application to products for other markets.

On the other hand, industry representatives argue that IR&D benefits are sometimes balanced unfairly in favor of the government (Tri-Association Ad Hoc Committee, 1974a, p. 26). They point out that often IR&D projects directed at commercial product objectives turn out to have significant value for military and space applications. In addition, the requirement of potential military relevance bars from allowability the costs of projects that, because of the unanticipated results of research, may later become important to DOD and NASA.

Whether either argument has legitimacy will be difficult to ascertain. Nevertheless, an attempt could be made to clarify the following questions:

1. To what extent does the method of IR&D fund allocations lead to improper subsidization of commercial or military/space products?

2. If such an imbalance can be shown to exist, is this an important issue in the broad social context?

Patent Policy

Unlike the rights to the outputs of contract RDT&E activities funded by DOD and NASA, which belong to the government, patent rights to inventions and new processes developed under IR&D funding are the sole property of the individual firms, except that government is not obligated for royalty payments for use of the patent by the inventor in performing a government contract. Other firms--even if they use the invention in work done for the government--have no rights of access to the invention or new process other than those normally available through licensing. The underlying argument (Tri-Association Ad Hoc Committee, 1974c) is that IR&D is a cost of doing business and thus an activity internal to the company, which should retain the rights and privileges flowing from it. However, some (e.g., U.S. Congress, Senate, 1975, pp. 687ff, 703ff) argue in response that, since the R&D in question is in part reimbursed by the government, others should share in the inventions, free of restraints and restrictions under the patent laws.

A number of questions could be explored:

1. Do the special features of the IR&D system justify denying contractors the benefit of patent protection afforded inventions made outside of the program?
2. What are the benefits or costs to the government of current policy?
3. Would vesting patent rights in the government have significant effects on the compositions of firms' IR&D programs? (Would it, for example, induce companies to keep the most valuable results to themselves by withholding particularly promising concepts from IR&D funding?)
4. Should mandatory licensing of patents obtained under the IR&D program be required for work on DOD and NASA contracts?

ACCOUNTABILITY AND MANAGEMENT

The issues of accountability and management controls are the sources of most of the current political interest in the IR&D funding system. Most of the criticism has been aimed at the government's intentionally loose control over the technical directions of IR&D work, and at the company-confidential nature of IR&D projects' technical details. IR&D payments are not subject to congressional oversight or public disclosure (though Congress each year receives a brief classified report giving the names

of the largest recipients of IR&D funds and the total amount reimbursed). Financial accountability is addressed through the Department of Defense's audit of IR&D expenditures. Accountability for the program's content is addressed in DOD by the technical evaluation process, but it is not subject to wider review.

Allowable IR&D costs are reimbursed to companies on a pro rata basis under a negotiated ceiling according to the share of each company's (or profit center's) business accounted for by the Department of Defense or NASA. A planned project's allowability is subject only to a determination of its "potential military relevance," technical adequacy, and reasonableness. The funds are spent at the company's discretion, with no overt direction from the government except for the allowability constraints. (Chapter 3 outlines the current administrative procedures.) Government program personnel and other sources of information on DOD and NASA intentions may informally suggest directions to industrial IR&D programs (Reppy, 1976), but industry emphasizes the independence of IR&D work.

This general arrangement is defended by the Department of Defense and NASA as a means of nurturing a strong and diverse private defense and space establishment, able to respond quickly, competitively, and creatively to emerging government needs. The existing controls provide a nearly optimal degree of accountability, in this view, and the degree of independence yielded to the contractors has benefits to the nation that outweigh the resulting loss of accountability (Gamota, 1980a, 1980b; Olstad, 1980). Industry, however, finds even the present management controls onerous and urges reliance on competitive pressures to control overhead expenditures in general. A 1974 report by the Tri-Association Ad Hoc Committee on IR&D and B&P (1974a, p. 15) extends the argument with the contention that the requirement for potential military relationship is an undue constraint, and is "definitely not in the best interest of the government when it inhibits defense and space industries from addressing problems of social, environmental, energy and other areas of concern." A governmentwide relevance requirement would be more sensible, this report claims.

At the other end of the spectrum, critics like Senator William Proxmire and Admiral Hyman Rickover regard the competitive pressures to control R&D expenses as very weak in the defense and space markets (IEEE Spectrum, 1976; U.S. Congress, Senate, 1975, pp. 687ff). Both call for government-funded R&D to be done on a strict contract basis, with subject matter and level of effort specified and controlled by the funding agency and with conventional congressional oversight.

Concern for accountability must be tempered by a reluctance to reduce or eliminate the organizational flexibility that may be the most important feature of IR&D. Additional controls should not be imposed without a clear idea of the benefits and costs of such a step. Accountability and management procedures can be evaluated only in terms of the agreed-upon objectives of the IR&D program and with full consideration of the impacts discussed in the prior section of this chapter.

Judging the issues surrounding management and accountability requires a thorough understanding of the decisionmaking and procedural details employed currently within DOD and NASA.

Questions to be addressed include the following:

1. How do DOD and NASA control the limits of cost allow-ability for the total IR&D program? What are the criteria that govern the limits? Do considerations of the program's objectives and impacts enter into the decisions?
2. Is the program of an optimal size to serve the official goals? What would be the effect on the program's contributions to innovation, competition in bidding, and the economic stability of contractors if it were increased or decreased in size by a substantial amount?
3. What are the program's impacts on the in-house R&D programs of defense contractors? For example, what additional management costs are incurred, and how do the relevance requirement and review by government technical evaluators influence the composition of in-house R&D?
4. No specific accounting is kept of the government's administrative costs in monitoring the IR&D program, though these costs appear to be significant. Can they be estimated and related to the overall costs and benefits of this monitoring?
5. What are the benefits of the technical evaluation in terms of the following:
 - Incentives for contractor technical personnel to propose high-quality R&D programs
 - Communications between contractor and government technical personnel
 - The influence of evaluations on negotiated ceilings.

How do the benefits compare with the costs?

6. Are on-site evaluations worth their cost? How much do they improve communications between contractors and government personnel, and what is their effect on the results of the technical evaluations?
7. Should technical evaluations weigh more or less heavily than they do now in the IR&D ceiling and reimbursement decisions for individual firms?
8. Does the military relevance requirement affect NASA's interests adversely?
9. To what extent do DOD program managers influence contractors'

IR&D programming toward their special areas of interest? What are the impacts? (Bias toward short-term work? Preselection of bidders?)

10. How well do individual firms manage their IR&D programs? What are their criteria for project selection? How well do they reflect DOD and NASA criteria and the goals of the program?
11. Are there systematic biases in the technical evaluation or negotiation procedures used by different services? Are different industries treated equitably?

Chapter 5
A SUGGESTED METHODOLOGY FOR A STUDY OF THE ROLE
OF IR&D IN DEFENSE AND SPACE SYSTEMS ACQUISITIONS

Chapter 4 describes the issues that should be examined in assessing the IR&D program, while Appendix A lists various proposed policy options. One charge of this committee is to enumerate and clarify the issues and alternatives, and to remain otherwise neutral. This chapter is intended to meet our further charge, of outlining a methodological framework for use by a future study committee in undertaking a critical analysis of the IR&D program.

The appropriate methodology for developing an understanding of the issues raised in this report combines traditional social science and econometric techniques with technical judgment and an appreciation of the complex national security, managerial, and historical contexts within which IR&D decisions are made. The real effects may be difficult to observe, the observed effects may not be the critical ones, and the cause-and-effect relationships may be subtle or obscured by layers of bureaucracy and years of informal and undocumented evolution of procedures.

The various analytical techniques are, of course, only as good as the data available. The history of accuracy, completeness, and availability of data on IR&D reimbursement is not an encouraging one and leads the committee to suspect that even the most painstakingly designed and implemented research project will yield little real insight unless considerably more and better data can be made available. The following discussion of methodology is offered with the caution that access to data is likely to be a problem and that judgment, rather than quantitative techniques, will be the basis of most of the analysis.

AN AGENDA FOR A STUDY

The following is suggested as an agenda for the deliberations of the study committee. The methodology is essentially the sequence of the following analyses.

1. Analyzing the "cost-of-doing-business" rationale for allowing IR&D costs as overhead items

This is an issue of fundamental importance. If IR&D were accepted at face value as a necessary part of contractors' technical operations, then simple logic would suggest that contractors be reimbursed without further justification or control, except for criteria of reasonableness and financial accountability. This would be directly parallel to normal commercial practice.

However, monopsony market considerations, and the existence of the vigorous contract RDT&E program, may be valid reasons for questioning the "cost-of-doing-business" rationale in the case of IR&D. The study group should clarify these fundamental issues as a necessary preliminary to its further investigations.

2. Appraising the objectives of the current IR&D program, beyond the justification of reimbursing contractors for a "necessary cost of doing business"

The history of the IR&D system indicates that the "cost-of-doing-business" rationale has not been universally accepted. The study group should also appraise the three stated official objectives for the IR&D system, as expressed in DOD Instruction 5100.66 (U.S. Department of Defense, 1975): to promote innovation, enhance technological competition in bidding, and provide contractors a measure of economic stability. Are these, in principle, proper and sufficient objectives, from the viewpoints of both government and industry?

Interviews with contractor and government personnel should suggest the extent to which participants act consistently to further the different official objectives, and whether other, unintended objectives influence the behavior of participants. These interviews should be carried out to provide a suitably varied set of case histories, accounting for differences in the sizes of firms and of R&D budgets, industry-to-industry variations in R&D intensity, and so on. This effort should be conducted by experienced R&D managers capable of drawing the subtle inferences that will be necessary in judging these questions; purely quantitative analysis will be of very limited value in this part of the study.

As a step in clarifying the functions of the IR&D system in the conduct of effective technical programs by contractors, it may be worthwhile to consider the extreme scenario in which IR&D support is unavailable. What would be the impacts on industry and government? What options would be available to contractors' R&D managers and DOD program personnel?

3. Assessing the current IR&D program's effectiveness in furthering its objectives

One of the study group's important tasks will be appraising the extent to which the current IR&D program has furthered its official objectives (U.S. Department of Defense, 1975) of promoting innovation, enhancing competition in bidding, and

bolstering the economic stability of DOD and NASA contractors.

We recommend that the study of this question begin by conducting three subsidiary studies, each investigating one of the official objectives cited in DOD Instruction 5100.66. A subcommittee should be established to conduct each of these subsidiary investigations. Issues and concerns in the three will inevitably overlap, but as long as each focuses on its principal subject, such redundancy will not be undesirable. In fact, it may help clarify the issues when the results are later drawn together by the full study group for an overall program evaluation.

The issues raised in Chapter 4 should, of course, be the framework for designing the agenda of each subsidiary study. An attempt should be made to appraise the effectiveness of the program in a comprehensive way. Are the three stated objectives viewed in the same light by all participants? Does the IR&D program in practice pursue the three as its principal targets, or do participants seek other goals (perhaps equally justifiable)? Are the stated objectives compatible with one another? If not, is this an important drawback to the IR&D program? (Varying goals may be desirable as business cycles and other changes in environment take place.)

The study should also question whether and to what extent current implementation policies and procedures hinder government and industry in fulfilling their obligations; the manner in which IR&D funding interacts with the contract RDT&E programs of DOD and NASA (whether, in fact, the hoped-for complementary relationship is realized in practice); and the extent to which past experience supports the value of the IR&D program.

Innovation. In assessing the IR&D program's contributions to innovation, the contemplated subsidiary study will probably be unable to examine directly the use of IR&D funds by contractors. Such information has traditionally been regarded as proprietary to the companies, and in all likelihood would be made available to the study on so selective a basis as to be uninformative. Moreover, past studies of innovation have shown that it is extremely difficult to trace the origins of new ideas to specific formalized project efforts. Such ideas generally require recognition of (1) an emerging need, (2) advances in allied technical fields that fill gaps in existing capabilities and thus allow a concept to become a practical possibility, and (3) a market waiting to be served. It is such combinations that blossom into "innovations." A feasible approach to this issue is to have experienced R&D managers and theorists estimate the program's likely contributions to the development of new concepts and innovative systems by assessing the peculiar opportunities for innovation offered by the system, in light of the typical amounts reimbursed, the administrative controls imposed by the government and the contractors, and other pertinent factors. The result should be a qualitative consensus view of the program's likely value in fostering technological innovation.

Competition in bidding. The study could use a combination of quantitative and qualitative analysis in estimating the IR&D program's contribution to technological competition in bidding. The study might, for example, attempt to find correlations between contractors' IR&D reimbursements and their responses to specific requests for proposals; so many possible perturbing factors may be obscured by the veil of proprietary interest, however, that this approach will probably produce at best suggestive results without quantitative significance. The results of such an analysis should be supplemented by judgments drawn from interviews with a variety of personnel from contractors, noncontractors, and government, to determine the typical patterns of allocation of IR&D funds and their likely influence on representative acquisitions.

Contractor's economic stability. Expert judgment based on the results of interviews will, once again, be the major tool in interpreting the IR&D program's success in fostering contractors' economic stability. R&D managers in a wide variety of contractor firms could be polled to determine their strategies in allocating IR&D funds. Do they see these funds as sources of support for efforts to diversify into new product lines? Do they use the funds to support key R&D workers in periods when contract demand for these workers' services is slack? Does the availability of IR&D funds significantly influence the amounts of their own funds that contractors allocate to R&D, or the areas in which such funds are spent? How do contractors' bid-and-proposal (B&P) and IR&D efforts interact to smooth the flow of R&D funds?

4. Investigation of the possible impacts of market distortions introduced by the IR&D system

Observers of the IR&D system contend variously that it establishes undesirable market conditions (a) by funding contractors and not potential contractors and thus serving as a barrier to entry into the DOD and NASA markets, (b) by causing contractors' commercial customers unwittingly to subsidize military R&D (or vice versa), and (c) by vesting of patent rights to inventions produced with IR&D funding solely in the contractors, yielding contractors unfair market advantages and inhibiting the wide adoption of new technology.

The net effects of these market imperfections would be very difficult, perhaps impossible, to quantify, depending as they do on the cumulative impacts of many thousands of technical and business decisions on the parts of contractor and government personnel. The practical difficulties will be intensified by the proprietary nature of much vital information. However, some measurements might yield rough indications of these effects.

For example, the contention that IR&D funding serves as a barrier to entry into these markets could be tested by comparing rates of entry into specific sectors of the DOD and NASA market

with measurements of the amounts of IR&D funds distributed to firms already in each sector. Rates of departure from those sectors might also be correlated with IR&D funds as a proportion of R&D expenditures in each sector. If IR&D funding is indeed a barrier, then sectors with a relatively large use of such funding should exhibit the lowest entry and departure rates.

The issue of cross-subsidization of commercial by government customers, or the converse, could be assessed roughly by attempting to correlate IR&D payments in a variety of product lines, company by company, with the proportions of commercial sales to DOD and NASA sales in those product lines. (This kind of analysis would require a level of access to contractors' commercial records that could be achieved only under strict standards of confidentiality. It is doubtful that such access would be granted widely enough and freely enough to give this kind of investigation more than suggestive value as an indicator of the program's tendencies.)

The effects of patent policy might be measured by correlating the number of patents with the relative importance of IR&D funding, for a variety of sectors or product lines. Comparisons could be made between sectors using a great deal of IR&D funding and those using relatively little and between firms with high IR&D budgets and either firms that accept little or no IR&D reimbursement or the industry as a whole. These measurements could be supplemented by case histories constructed so as to illuminate the patent licensing practices of DOD and NASA suppliers.

As should be obvious from reading the above discussion of research methods, quantitative measurements and econometric studies will have limited value in judging the market effects of the IR&D system. The difficulty of obtaining reliable samples of data from a body of information considered proprietary by its holders is the most obvious problem in this regard. A more fundamental problem, however, is the inherent role of judgment and experience in determining the subtle market effects of the program. In any thorough study of these effects, the probity and balance of the study group will be far more decisive than any quantitative measurements, econometric models, or statistical studies.

5. Overall appraisal of the current IR&D program

The IR&D program in its current form has evolved over many years by a process of gradual adjustment. Substantive changes in the program should not be made unless major deficiencies are uncovered. The study committee, after carrying out the investigations outlined above, should be in a position to form an opinion on the utility and importance of the program as currently defined.

In the event that the study group finds major difficulties with the IR&D program, it should be in a position to offer recommendations for improving current practices. These recommendations should be incorporated in the group's findings.

A FINAL OBSERVATION

It is clear that an in-depth study of the IR&D system will be a difficult task. The annotated bibliography in Appendix B and the historical overview of Chapter 2 provide ample evidence of the extensive and continuing attention given the subject by past observers.

The polarization of viewpoints that has been evident among those defending and attacking the current system arises from the fact that most of the substantive issues to be resolved are largely judgmental in character. This same judgmental quality characterizes all studies of how best to conduct research and development. The point of agreement in all cases is that creative R&D is the essential starting point for technological advance; how best to organize an effective R&D program is a subject for many opinions.

APPENDIX A

ALTERNATIVES TO PRESENT METHODS OF IR&D FUNDING

Complementing Chapter 4's discussion of the issues, this appendix examines many methods for funding independent R&D that have been suggested over the past decade, and raises some issues for consideration along with each. Although none of these alternatives has been adopted, they form a part of the historical debate over proper approaches to dealing with IR&D. As such, issues are highlighted in the course of the supporting discussions. They are mentioned here even though many are repetitions of those discussed in Chapter 4.

The alternatives presented here can generally be separated into three categories. Some represent efforts to reduce government controls and administrative costs. Others would increase accountability and government control. Still others are intended to increase the value and effective use of the results of IR&D. These three categories, decreased government control, increased accountability, and enhanced utilization of results, form the three major sections of the discussion that follows.

One alternative (Comptroller General, 1975, pp. 48-50), however, cannot be included in any of these categories. It is a simple proposal to abolish the entire program as unnecessary. According to this view, the government could contract directly for all of its R&D needs. Senator William Proxmire (U.S. Congress, Senate, 1975, pp. 687ff.) and Admiral Hyman Rickover (U.S. Congress, Senate, 1975, pp. 703ff) are the most vocal proponents of this alternative. Other suggested alternatives presented below would disallow costs of IR&D but would compensate for these efforts in some other way.

ALTERNATIVES THAT WOULD REDUCE GOVERNMENT CONTROLS

Remove Requirements for Potential Military Relevance, Technical Reviews, and Ceilings

From the point of view of defense contractors, this is the most equitable adjustment that could be made--allowing them to recover legitimate costs of doing business from all sales, including those to DOD or NASA. Some contractors view the requirement of potential military relevance (PMR) as unnecessary, and sometimes meaningless, in that nearly every area of research can be shown to have potential military relevance, although such demonstrations and evaluations are costly and time consuming.

The PMR requirement was introduced in the 1971 Military Procurement Authorization Act (P.L. 91-441, sec. 203). Earlier procurement practice required a direct and apparent relationship to a military operation or function. The 1971 authorization followed extensive hearings on IR&D (U.S. Congress, Senate, 1970), in which Senator Alan Cranston and others objected to the military relevance requirement. Senator Cranston cited, as the prevailing view of Congress at that time, the opinion that IR&D reimbursement was supposed to enable defense contractors to diversify into nondefense markets (pp. 1676-1693, 1772-1791). When the Senate bill for 1971 included the old language requiring a direct military relationship and the House bill made no mention of relevance, "potential military relevance" was adopted as a compromise (Bethel, 1975, pp.40).

A number of questions are raised by proposals to abolish the PMR requirement. Does the requirement lead contractors' managements to favor R&D projects that show promise of immediate application, to the detriment of basic research needs (Comptroller General, 1975, p. 82; DGS Associates, 1976, p. 6)? Does the requirement bias IR&D efforts against NASA interests? Would lifting the PMR requirement allow defense contractors to plan more long-term, cost-effective research programs (Tri-Association Ad Hoc Committee, 1974, p. 26)? Would it make defense contracts more attractive to commercial firms and thus foster competition? Would this move relieve the financial burden on commercial customers, who now (according to some) bear "more than their share" of IR&D costs to cover projects disallowed on government contracts (United Technologies, 1976, p. 2; U.S. Congress, Senate, 1970, p. 1849)? Would it unfairly subsidize defense contractors commercial R&D (Reppy and Long, 1976, p. 35)?

Eliminating technical evaluations has also been suggested as an improvement over present procedures, one that would allow defense contractors to operate under the inherent economic constraints "already present in the highly competitive defense and commercial marketplaces" (Tri-Association Ad Hoc Committee, 1974a, p. 20). Some claim that technical evaluations do not in any case substantially affect ceiling negotiations (Reppy and Long, 1976, p. 34), and that initial program evaluations are not adequately checked by final evaluations of completed projects.

Industry favors lifting all restrictions and ceilings on reimbursements, as "artificial limitations on recovery of legitimate costs of doing business" (United Technologies, 1976, p. 2; Tri-Association Ad Hoc Committee, 1974, p. 17). Criteria of reasonableness and allocability could still be applied, and ceilings might be necessary, they suggest, only when a contractor operates exclusively on sole-source government contracts. Criteria of reasonableness and allocability would still be applied. Administrative costs would be reduced, and contractors would have the maximum degree of flexibility in allocating resources (Comptroller General, 1975, p. 53). Unwise allocation would result in higher bids and prices in the future, and this "ceiling," competitively set, would be sufficient to limit expenditures (Tri-Association Ad Hoc Committee, 1974, p. 26).

Critics of this approach ask how reasonableness would be determined (Commission on Government Procurement, 1972, pp. 38-39), and whether decreased "feedback" from DOD would mean that fewer IR&D projects would be judged relevant to defense concerns (Comptroller General, 1975, p. 54).

Reimburse IR&D Costs by Increasing Profit Margins

Methods for increasing defense and aerospace contract profit margins to allow for IR&D costs have been the subject of debate over the past decade (Comptroller General, 1975, p. 64-67; Reppy, 1976, p. 54). A uniform increase in the rate of profit allowed on government contracts would allow companies that conduct little or no R&D to reap unfair profits, critics say. The General Accounting Office (Comptroller General, 1975, p. 54)

suggested that the IR&D reimbursement element might be added "below the profit line," allowing the rate to vary from firm to firm according to such factors as the percentage of sales to DOD and NASA. Other suggestions include establishing different rates of profit for different industries, based on industry-wide averages for government contracts and commercial sales, or letting the Renegotiation Board evaluate IR&D expenses in examining contract profits (Comptroller General, 1975, p. 65).

Some questions are raised by these suggestions. Would inequities result from equal profit margins' being applied to firms with wide differences in the amount and quality of IR&D undertaken? Would subcontractors (who do a large portion of defense work) be reimbursed equitably? Would Congress raise statutory profit limits enough to cover IR&D costs? Would profits be "whittled away" during contract negotiations? Would the total amount of IR&D undertaken diminish? Would increased company profits really be channeled into IR&D, especially during periods of declining sales? How could agency contracting representatives be made aware of ongoing IR&D programs in each firm? Would this system serve to reward bargaining ability more than quality of research? Would administrative costs be reduced? Would firms have added incentives to bid for defense contracts?

Industry representatives (Tri-Association Ad Hoc Committee, 1974c, pp. 16-25) complain that this change would, more than the present system, subject IR&D to fluctuations in sales and in inflation, and that continuity in IR&D planning would be no greater than under the present system. Furthermore, they complain, this arrangement categorizes costs incorrectly: IR&D is a necessary cost of doing business, not a means of earning greater profit. Finally, critics of defense spending who feel that profits are already too high could interpret this change as a subsidy to DOD and NASA contractors.

Determine IR&D Allowances by Formula

Using a formula to establish IR&D ceilings or reimbursements has been suggested as a means of reducing administrative costs of the program and applying a more nearly uniform procedure to all contractors (U.S. Congress, Senate, 1970, p. 1835; Comptroller General, 1975, pp. 54-58). Could technical and relevancy evaluations be eliminated? Would total IR&D expenditures increase? Would ongoing IR&D projects be less visible to DOD, due to decreased on-site visits and reviews?

The "contractor weighted average share of risk" (CWAS) formula assigns a rating to each contractor based on the proportion of business consisting of fixed-price contracts and commercial sales, on the premise that this fraction is a measure of incentives to control costs. The rating is decreased by the (weighted) proportion of cost-type contracts. Allowing contractors with a CWAS rating over a certain threshold, possibly 65 percent, to recover IR&D expenditures through overhead without restrictions has been suggested (Comptroller General, 1975, p. 54). Other contractors,

relying more heavily on cost-type contracts, would be required to negotiate advance agreements or would be subject to a second formula.

A second suggestion for formula determination of IR&D allowability is applying to all contractors the formula that is at present applied to DOD contractors recovering less than \$4 million in IR&D expenditures during the previous year. An amount approximately equal to the average of IR&D costs over the two highest of the preceding three years, modified up to 20 percent by anticipated DOD and NASA sales in the coming year, could be recovered by all contractors through overhead without restrictions.

A third suggestion for formula application would combine elements of each of the first two. Contractor cost centers with 50 percent or more fixed-price contracts and commercial sales would have IR&D costs accepted as overhead costs, subject to tests of reasonableness and allocability (Commission on Government Procurement, 1972, pp. 31-32). Contractors having 50 percent or more cost-type contracts would have the present DOD formula applied and would negotiate ceilings for IR&D and B&P, based on relevancy tests.

The General Accounting Office (Comptroller General, 1975, p. 56) recommends that applying the present formula to all contractors, rather than only those below the \$4-million threshold, would require modifications such as basing the formula on more than three years' sales, to equalize unusual market fluctuations.

The formula would be used to determine allowable ceiling costs, not actual reimbursements, and a mechanism would be necessary for appealing individual cases of apparent inequity.

Some questions are raised by these suggestions. Would eliminating advance agreements also eliminate the opportunity for DOD and NASA to monitor the quality of management and technical competence of IR&D efforts? Would overall IR&D costs increase (by as much as \$100 million, as estimated by DOD) (Commission on Government Procurement, 1972, p. 40)?

Opponents of the application of such thresholds point out that the 50-percent contract distinction would result in several major contractors' having no relevancy test or advance agreements, while some very small contractors would be subject to tests and agreements. The effect would be that the government would spend a great deal of time and money administering small IR&D reimbursements. Since negotiated ceilings are now generally lower than figures arrived at by formula, government expenditures would also increase (Comptroller General, 1975, p. 57).

Critics of the application of the CWAS formula point to the fact that it may not be a measure of cost-consciousness. The advantage of simple, mechanical application across the board may be outweighed by its questionable validity as a measure of incentives that are based on other factors in addition to the types of contracts negotiated. Would small companies be discouraged from entering the defense market? Would some companies simply reorganize contracts according to type to avoid relevancy requirements (Commission on Government Procurement, 1972, p. 40)? Would this arrangement allow companies to plan IR&D over several years? Would slight improvements in contractor flexibility be outweighed by the penalizing effect against those with cost-type contracts (Tri-Association Ad Hoc Committee, 1974c, p. 26)?

Fund IR&D on a Multi-Year Basis

Continuity of ongoing research projects is important in planning, allocating resources, and maintaining competent personnel. Year-to-year variations in funding are disruptive and result in inefficient program changes. One suggestion for evening out annual variations in funding is that a blanket, two- or three-year contract be negotiated with each contractor, specifying broad parameters for the pursuit of "nationally relevant" research (Commission on Government Procurement, 1972, p. 42). Contractors would be required to disclose the sources and applications of funds but, independence of management would be maintained.

A second suggested multi-year arrangement would be for government agencies to announce areas in which R&D is needed and the percentage of the costs they would be willing to fund in each case (Commission on Government Procurement, 1972, p. 41). This plan, which would supplement but not replace a larger program for funding contractor-initiated R&D, would require public disclosure or audit of expenditures to ensure relevance to intended research topics.

Establish Nonprofit IR&D Cost Centers

Nonprofit cost centers could also supplement contractors' R&D programs (Commission on Government Procurement, 1972, p. 41). Contractors could participate on a voluntary basis and would be required to disclose the applications of funds received through grants or contract. Incentives for participation could be full patent rights, tax incentives, and the possibility of generating new ideas and future contracts.

Fund Some IR&D Projects Through Block Grants, Loans, and Tax Incentives

Another supplement to a larger program of R&D funding could be a combination of grants, guaranteed and low-interest loans, and tax incentives to encourage independent R&D efforts (Commission on Government Procurement, 1972, p. 41), possibly funded over periods of several years. Grants to individuals or laboratories, through professional societies or other organizations, might result in new directions in research and possible new areas of innovation. Similar considerations to industry, as supplements to ongoing R&D programs, might increase contractor independence without removing controls on total costs to government. GAO recommended that these options be studied by the Office of Federal Procurement Policy (Comptroller General, 1975, p. 82) as a means of stimulating innovation and compensating contractors fairly for R&D undertaken in the national interest.

ALTERNATIVES THAT WOULD INCREASE ACCOUNTABILITY AND GOVERNMENT CONTROL

Some complaints about present IR&D funding procedures concern the degree of company-confidentiality afforded IR&D project results. Contractors need not release details of company research programs to public view.

In an effort to fulfill their responsibility for budgetary oversight, some members of Congress and others have asked why more accountability is not required, particularly since some companies rely almost entirely on government contracts.

Allow Government Access to Commercial Records

In an effort to verify the allowability of questionable IR&D costs, the General Accounting Office has in some cases requested access to sufficient contractor records to confirm that work charged to IR&D was not required in fulfilling other contracts (Comptroller General, 1977). Access to these records, as well as to some documents available to commercial customers, has been repeatedly denied on the grounds that there was no legal basis for such access (Comptroller General 1977a, p. 18-22; Pratt & Whitney [letter to R. W. Gutmann] in Comptroller General 1977a, p. 28). GAO recommended that access to contractors' commercial records, sufficient to verify questionable costs, be required by DOD or by Congress as a condition for receiving IR&D funding. DOD responded that such access was unnecessary, the certified word of the contractor being sufficient (Comptroller General, 1977).

Fund IR&D as a Line Item or Under Separate Contracts

In 1969, Senator William Proxmire, as chairman of the Subcommittee on Priorities and Economy in Government, introduced Senate Bill 3003, limiting Defense Department payments for research to specific projects approved in contract negotiations. R&D costs would appear as line items of benefit to specific contracts, or as separate research contracts. S.3003 was withdrawn pending hearings to evaluate the existing IR&D reimbursement procedures.

During the 1970 hearings, industry, DOD, and congressional representatives testified against the proposed bill, although many suggestions for changing the IR&D program at the time were introduced. Some changes were included in the 1971 authorizing legislation (P.L. 91-441), and in 1975 DOD issued a revised "instruction" (DOD Instruction 5100.66) stating the general goals of the program (U.S. Department of Defense, 1975), but the debate about line itemizing IR&D costs continued throughout the 1970s, interrupted only by GAO reports requesting clarification (Comptroller General, 1970, 1974b, 1975, 1977).

Contracting for and line itemizing IR&D would increase government oversight and cost control, ensure relevance, and gain patent rights for government use. On the other hand, it is asked, would loss of contractor's independence impair the usefulness of the program? Would followup on good ideas be delayed by bureaucratic negotiations? Would granting patent rights to the government serve the best interests of the nation? Would contractors losing out on one contract fall so far behind in that area that future bids would be impossible (Comptroller General, 1975, pp. 60-62)? Would R&D programs suffer from the lack of continuity in

year-to-year funding? Would government lose sight of independent R&D in commercial product areas (Comptroller General, 1975, p. 62)? Is there any assurance that the decrease in defense allocations for procurements now allotted to IR&D would be complemented by an equivalent increase in RDT&E authorizations?

So-called level-of-effort contracts, giving only general guidance as to subject matter, might be better suited to contracting IR&D than more specific direct contracts (Reppy, 1976, p. 53; Reppy and Long, 1976), assigning to IR the costs of gaining and communicating new "non-applied" knowledge, ideas, and design concepts, while classifying as ID current product improvement and technical activities in preparation for engineering contract change proposals. Costs of IR deemed to have broad national relevance could be allocated to all sales and contracts. Product improvement costs (ID) would be allocated to related product sales; if resulting new ideas led to new product development, direct contracts could be used. Bid and proposal (B&P) expenses would not be allowable costs under this arrangement, but most B&P expenditures would be absorbed by ID allowances.

Since IR would be subject to a relevancy requirement, federal agencies would state "mission needs" and goals to provide a basis and motivation for research in these areas. Some IR might be judged relevant without being directly responsive to such mission need statements. If such efforts led to new perceived needs, direct contracts could be negotiated.

A second possible distinction between the costs of independent research and independent development (Fundingsland, 1973, p. 9) involves allocating the costs of research concerning present product lines to those product lines as overhead. The costs of launching new ventures, developing new products, or entering new markets would be recovered in the prices of the resulting future products, and could in the meantime be offset by some of the suggestions from dissenting position 2 of the Commission on Government Procurement's (1972, p. 41-42), Recommendation 10, such as a combination of low-interest loans and tax incentives. Exploratory research, not applicable to any existing product line, would be regarded as a corporate expense and would be allocated to all company sales.

One uncertainty that arises in considering the distinction between present and new product lines, is the point at which product improvement becomes a "new" venture. Industry objections to these alternatives are based on the premise that IR and ID cannot be separated. The effort required to budget for and demonstrate allowable costs would be prohibitive, and year-to-year continuity in R&D funding would suffer (Tri-Association Ad Hoc Committee, 1974, p. 26). Cost recovery would be inequitable, in this view, since contractors' costs would be unevenly reflected across sales, and competition would suffer due to the financial risks involved.

Establish Separate Centers for Government R&D

Separate centers for government-sponsored research might be established for funding IR&D, with some balance between government control of funds and independent decisionmaking authority for the contractor. In 1975,

GAO considered the practicability of establishing an independent government agency to be responsible for IR&D on a government-wide basis (Comptroller General, 1975, pp. 78-79), a suggestion strongly opposed by DOD and industry (Tri-Association Ad Hoc Committee, 1974, pp. 311-312).

Defense concerns were that R&D directed toward all government agencies would not give high enough priority to defense-related research, and that innovative ideas would be poorly received by program managers who lacked independence in allocating resources. NASA officials agreed, saying that centralized control would hamper creativity and emphasize government-wide relevance to the detriment of some agency needs, even if the IR&D agency were solely responsible for contracting for or funding IR&D (Comptroller General, 1975, pp. 78-79). Other government agencies commented that their existing satisfactory arrangements should not be altered to accommodate problems in funding defense-related research.

Under the AEC system for funding IR&D, about 80 percent of procurement contracts were with government-owned, contractor-operated plants, under no-risk, cost-type contracts (Comptroller General, 1975, p. 73). AEC owned the facilities, provided the materials, and advanced funding. Only those IR&D costs shown to benefit AEC contracts or interests were allowed. AEC acquired rights to data and inventions based on its percentage shares of total project costs (Comptroller General, 1975, p. 75).

Separate IR&D From B&P Costs

Since different business demands lead to IR&D and bid and proposal (B&P) expenses, the two could be separated, at least theoretically. At present IR&D and B&P costs are interchangeable within the total ceiling limitation, but needs for IR&D can usually be foreseen more accurately than those for B&P efforts. B&P activity often must increase during periods of declining sales, when IR&D funding also decreases and when concomitant diversion of funds from IR&D accounts to B&P accounts could be damaging. Industry argues that both IR&D and B&P costs should increase when sales decline (Tri-Association Ad Hoc Committee, 1974a, p. 310) and maintains that separating the two would constitute "gameplaying," impose "artificial" controls, and be very difficult to administer.

Bethel discusses the temptation and the ease of transferring IR&D costs into the B&P category, if the ceiling on B&P costs alone were removed (Bethel, 1975, p. 93-95). In response to a suggestion that separate ceilings be set on IR&D and B&P, GAO concludes that budgeting for the two would be very difficult and would greatly increase the administrative costs of the IR&D program (Comptroller General, 1975, p. 42).

ALTERNATIVES AIMED AT ENHANCING THE VALUE AND USE OF IR&D RESULTS

Allow the Government Patent Rights
or License-Free Use of IR&D Results

Assigning the government patent rights or license-free use of patented

ideas generated by IR&D has been discussed (Comptroller General, 1975, p. 16-19) as a way of decreasing procurement costs to government. At present a few contractors, in advance negotiations, agree to license-free government use. Requiring this in all IR&D agreements is strongly opposed by contractors on the ground that retaining control of patents developed under IR&D (in contrast to contract R&D) is an important motivation to conduct independent research (Tri-Association Ad Hoc Committee, 1974, p. 13; see also U.S. Congress, Senate, 1970, pp. 1849-1868).

Evaluate Completed IR&D Projects

Evaluation of completed projects has been proposed as an alternative or a supplement to present brochure evaluation procedures (Reppy and Long, 1976, p. 35; Commission on Government Procurement, 1972, p. 42). After-the-fact ratings could be the basis for overhead adjustment on existing contracts or on those entered into during the following year. Critics of the present program point to the frequency with which IR&D managers deviate from brochures and the lack of adequate follow-up procedures. Contractors respond by saying that the nature of independent research requires the flexibility to allocate resources as considered appropriate by management, since project changes are often made necessary by unfolding events (U.S. Congress, Senate, 1970, pp. 1836-1873).

Quick-Response Mechanism

To accomplish some of the goals of the IR&D program as stated in DOD Instruction 5100.66 (see Chapter 4), a quick-response contract mechanism could be instituted. A company or individual could present an idea for original research on a contract basis, and the idea could be approved for contract without being subject to lengthy bid and proposal procedures. If such a mechanism were available, some of the innovations generated through IR&D could result from contract research, with concomitant advantages to the government in terms of accountability and patent rights. Some questions arise. Who would have the authority to approve such projects? How would accusations of favoritism and unfair practices be resolved? How much work presently funded under IR&D would be channeled into such a procedure? Would this be seen as favoring small companies and nondefense contractors?

Appendix B
ANNOTATED BIBLIOGRAPHY

Aerospace Industries Association of America, Inc. 1969. Independent Research and Development. May 19. Washington, D.C.: Aerospace Industries Association of America, Inc.

This position paper attacks "artificial" external control of IR&D/B&P costs as having jeopardized the national well being, by reducing technical competence and productivity. Industry should have the flexibility to direct research efforts in response to changing technology and economic factors. Government control of industrial research would result in poor choices of projects and reduced competition. Allocable shares of R&D costs are accurately reflected in shares of sales. The survival of the nation requires state-of-heart knowledge in defense contractors. Without ongoing, independent research programs, products and services would not be available when needed.

Defense-related research expenditures contribute to, rather than reduce, efforts to improve life in general, and, it is argued, defense-related R&D expenditures are much lower than R&D expenditures by high technology commercial industries.

. 1971a. "National Technology Support: A Study of Research and Development Trends and Their Implications." Washington, D.C.: Aerospace Industries Association of America, Inc.

. 1971b. "Industry Funded Research and Development." June. Washington, D.C.: Aerospace Industries Association of America, Inc.

. 1976. "The ABC's of IR&D. A Primer." Reprinted 1979. Washington, D.C.: Aerospace Industries Association of America, Inc.

. 1980. Research and Development: A Foundation for Innovation and Economic Growth. Washington, D.C.: Aerospace Industries of America, Inc., Aerospace Research Center.

American Association for the Advancement of Science. 1980. "Proceedings of an AAAS Symposium on January 8, 1980: How Much Does the Defense Department Advance Science?" Washington, D.C.: Naval Research Laboratory, September 24.

Anonymous. 1976. "OMB Considerations of an IR&D Policy: A Study to Determine if OMB Should Establish an Executive Branch Policy on Independent Research and Development" (Unpublished report prepared by staff of the Office of Management and Budget, Executive Office of the President.) September 30.

A review of some IR&D issues that recommends a uniform government-wide IR&D policy in the following words:

...recognizing the importance of IR&D/B&P to maintaining

competition in Federal procurement and in preservation of the free enterprise system, and to support the national policy for reliance on the private sector for needed Federal goods and services, it is recommended that OMB either sponsor or support legislation to recognize IR&D/B&P. A draft of the recommended legislation is contained in the attachment to this study.

It is further recommended that (the Office of Federal Procurement Policy) develop a uniform governmentwide policy for IR&D/B&P based on the proposed legislation. The uniform policy would:

- Recognize IR&D/B&P as necessary costs in Federal procurements.
- Require negotiated advance agreements with contractors whose IR&D/B&P expenses are \$3 million or more in negotiated Federal procurements; negotiation to be conducted by agency with the largest share.
- Require test of reasonableness in determining allowability of costs and require proration of such costs against contractors' total business base.

Aviation Week & Space Technology. 1980. "Lockheed Budgets \$500 million for Independent R&D Activities." May 19, p.22.

Badgett, Robert S. 1973. "The Allowability and Allocability of IR&D and B&P Costs." Master's thesis, Naval Postgraduate School, Monterey, California.

Bethel, Howard Emery. 1975. An Overview of DOD Policy for and Administration of Independent Research and Development. Silver Spring, Md.: Operations Research, Inc., Tactical Systems Division (Report No. DSMS-PMC-75-1).

This overview of IR&D policy and administration traces the development of the program from 1940, when DOD contract negotiations first recognized independent research as an allowable cost. Cost principles issued in 1959 were criticized throughout the 1960's. Current legislation allows wide variation--among firms and among the armed services and NASA--in negotiating procedures. For example, Air Force negotiators place greater emphasis on technical evaluations in negotiating ceilings for allowable costs than does the Army or Navy. A DOD-wide data bank helps program managers and negotiators, to some extent, in avoiding duplication of effort.

Questions regarding DOD administration of IR&D increased through the 1970's. Suggested alterations in procedures include congressional line item control of IR&D costs, or the removal of IR&D from overhead costs and allowing recovery through direct contract, increased profit, or tax credits.

Patent rights are also an area of controversy. Where IR&D is seen as company-initiated, rights are seen as belonging to the firm; those who emphasize the cost of IR&D to the government maintain that the taxpayers should not have to pay a second time for use of resulting new ideas.

This report views present procedures as, on the whole, a "reasonable balance of good stewardship of the taxpayer funds and satisfaction of the needs of industry," and concludes that any major change would disrupt this balance.

Section IV, "Major Areas of Controversy," outlines a number of criticisms of the IR&D program and briefly describes some of the proposed remedies. Appendices include several basic documents bearing on the history and administration of IR&D funding.

Brincefield, C.M. 1980. "Independent Research and Development Negotiation Process." Paper presented to the Committee on IR&D Issues, National Research Council, Washington, D.C., December 8.

Broad, William J. 1980 "Assault on Research Secrets at Pentagon." Science 207(February 22):849-851.

AT&T's antitrust lawyers demanded access to the files of DOD's \$1.24-billion IR&D program, looking for evidence to refute charges that AT&T dominated the telecommunications industry. Defense contractors objected, threatening to halt their participation in the IR&D program. DOD and the Department of Justice, joined by member organizations of the Tri-Association Ad Hoc Committee on IR&D, argued that national security would be endangered if access to the files were granted. An out-of-court settlement allowed AT&T access to nonproprietary, anonymous descriptions of project areas, funding, and manpower needs.

As a result, some contractors have considered reporting only general conclusions in technical reports and brochures, while others suggested that onsite reviews be conducted annually, reducing the need for written records. Broad speculates that threats to decrease participation might be designed to increase contractor independence through reduced reporting requirements.

Brooks, Harvey. 1981. "Notes on Some Issues on Technology and National Defense." Daedalus. Winter, pp. 129-136.

Business Week. 1978. "Vanishing Innovation." July 3. pp. 46-49, 52, 54.

Industrial innovation is important to national economic growth, the creation of new jobs, and increased productivity. Concern about the sharp decrease in innovation in American industry has been expressed by government, industry, and labor officials.

The federal commitment to R&D has decreased steadily over the past 20 years; basic research in industry has been reduced by half. At the same time research in areas relating to pending legislation and regulation has increased.

We have not capitalized on the new ideas generated outside the United States. Japanese and West German innovations in nondefense industries such as textile machinery development and steel production have not been adopted, while the Japanese, in particular, have successfully applied American ideas to their electronics industry.

Optimal use of research facilities in industry is discouraged by anti-trust legislation preventing companies from cooperating in research and exploratory development, and by large amounts of R&D time devoted to what are perceived as unrealistic fears of the public. Pollution control research, for example, uses time and resources which could be used to develop new processes to avoid pollution.

Investors are discouraged by capital gains tax laws and licensing regulations which diminish return on investment and increase financial risk. Good ideas do not always reach the public due to reporting requirements that involve thousands of pages to introduce even minor innovations; poor marketing techniques sometimes hamper industry knowledge and acceptance of government-sponsored research results.

This report suggests that legislators should know more about science and technology, before trying to regulate industry; the federal role in industry should be to encourage investment in all phases of research, development, and production.

Those who blame industry for some of the R&D lag in the United States describe the shift from long-term programs to short-term rewards through incentive programs. Ideas are sometimes retained in research programs long after they should be seen as unpromising. The location of the research division within the organization and the means of communication between divisions also influence the extent to which new ideas can be implemented throughout the organization.

In the interest of national growth and long-term economic survival, the entire relationship between the federal government and industrial research should be reassessed.

Carpenter, James. n.d. Independent Research and Development Special Project #1. Washington, D.C.: National Science Foundation.

Commission on Government Procurement. 1972. "Acquisition of Research and Development." In Report of the Commission on Government Procurement vol. 2, pp. 31-42. Washington, D.C.: U.S. Government Printing Office (stock number 5255-00003).

The commission recommends establishing a uniform government-wide policy on IR&D, in which contractors having over 50 percent fixed-price government contracts and commercial sales would have IR&D/B&P costs accepted as overhead, with no ceiling. Contractors with 50 percent cost-type contracts would have to demonstrate relevance of particular projects.

Two dissenting positions are presented. Dissenting position 1 would avoid the 50 percent contract distinction by retaining the requirement for advance agreements when IR&D/B&P reimbursements exceeded \$2 million in the previous fiscal year. The major change in present policy would be a requirement that government auditors be allowed access to a contractor's commercial records to verify allowability. This opinion argues that the 50 percent contract distinction would greatly increase costs and would cause some contractors to reorganize to avoid relevancy requirements.

Dissenting position 2 suggests a broader evaluation of ways to encourage industrial innovation while spending tax dollars in the national interest. Suggestions include undertaking a public relations and educational effort to make the benefits of IR&D more visible and understandable to the public. This view suggests that short-term solutions will not be found, and that efforts should be directed toward long-range accommodation. A single, uniform policy may not be best, considering the variety of contractors and projects involved. A combination of several different approaches might be best: funding specific individuals through grants to professional societies; announcing "favored" programs and allowing application for participation and funding; allowing contractors to operate separate IR&D divisions on a nonprofit basis; allocating grants or loans of various types to particular research programs over periods of time based on estimates of value and need; negotiating blanket contracts for 2-3 year periods for nonspecific, "nationally relevant" research projects and requiring public disclosure of source and application of funds; adjusting overhead costs according to evaluations of completed IR&D efforts rather than advance agreements, allowing investment tax credits or depletion allowances to offset one year's expenditures against a subsequent year's income, and shifting to return on investment as an overall profit policy, reducing profit by the amount of company-financed IR&D.

- Table attached, showing 1963-1970 breakdown of costs (Exhibit A)

Comptroller General of the United States. 1970. Allowances for Independent Research and Development Costs in Negotiated Contracts: Issues and Alternatives. February 16. B-164912. Washington, D.C.

_____. 1971. Feasibility of Treating Contractors' Independent Research and Development Costs as a Budget Line Item. March 8. B-164912. Washington, D.C.

TABLE 2. STATISTICS RELATING TO IR&D, B&P, AND OTE FOR MAJOR DEFENSE CONTRACTORS*
(Millions of dollars)

	1963	1964	1965	1966	1967	1968	1969	1970	1971
Sales									
Total Government and commercial	23,304	23,470	24,054	28,438	34,167	36,954	36,430	34,314	
Total DOD only	17,916	16,442	15,644	17,889	21,371	22,275	22,692	21,260	
% DOD sales to total sales	77%	70%	65%	63%	63%	61%	62%	62%	
IR&D									
Total industry cost incurred	389	419	439	502	591	752	808	714	707
Total reimbursed on DOD contracts	197	199	198	224	277	333	389	347	356
Amount reimbursed on DOD contracts									
As a % of total incurred	51%	47%	45%	45%	47%	44%	48%	49%	50%
As a % of DOD sales	1.10%	1.21%	1.26%	1.25%	1.30%	1.46%	1.73%	1.63%	
B&P									
Total industry cost incurred	236	252	277	315	338	387	426	411	
Total reimbursed on DOD contracts	178	182	186	202	230	275	286	275	
Amount reimbursed on DOD contracts									
As a % of total incurred	75%	72%	67%	64%	68%	71%	67%	67%	
As a % of DOD sales	0.99%	1.11%	1.19%	1.13%	1.08%	1.23%	1.26%	1.29%	
OTE									
Total industry cost incurred	157	182	237	238	292	252	178	169	
Total reimbursed on DOD contracts	84	71	76	91	92	77	79	73	
Amount reimbursed on DOD contracts									
As a % of total incurred	54%	39%	32%	38%	32%	31%	44%	43%	
As a % of DOD sales	0.47%	0.43%	0.49%	0.51%	0.43%	0.35%	0.35%	0.34%	
Grand Total									
IR&D, B&P, OTE incurred	782	853	953	1,055	1,221	1,391	1,412	1,294	
Total reimbursed by DOD	459	452	460	517	599	685	754	695	
Amount reimbursed by DOD									
As a % of total incurred	59%	53%	48%	49%	49%	49%	53%	54%	
As a % of DOD sales	2.56%	2.75%	2.94%	2.89%	2.80%	3.07%	3.32%	3.27%	
Total incurred as a % of total sales	3.36%	3.63%	3.96%	3.71%	3.57%	3.76%	3.88%	3.77%	

Sources: Senate hearings, authorization for Military Procurement Research and Development, Fiscal Year 1971, and Reserve Strength, Committee on Armed Services, 91st Cong., 2d sess., on S.3367 and H.R. 17123, Part 3, Mar. 2, 6, 9, 13, May 7, 12, 19, 27, June 11, 1970, p. 1944.

U.S. Comptroller General, Report B-164912, p. 87.

Memo from the Department of Defense, DDR&E, to the Commission, Feb. 7, 1972, pp. 1-2.

Congressional Record, Mar. 24, 1971, p. S3818.

*Percentage for fiscal years 1968-1970 calculated by the Commission.

. 1972. Implementation of Section 203, Public Law 91-441, On Payment for Independent Research and Development and Bid and Proposal Costs. April 17. B-167034. Washington, D.C.

. 1973. Payments for Independent Research and Development and Bid and Proposal Costs. Report to the Committee on Armed Services, United States Senate. April 16. B-167034. Washington, D.C.

. 1974a. Department of Defense's Implementation of Section 203, Public Law 91-441, Involving Contractors' Independent Research and Development. May 1. B-164912. Washington, D.C.

. 1974b. Independent Research and Development Allocations Should Not Absorb Costs of Commercial Development Work. Report to the Congress. December 10. Washington, D.C. (PSAD-75-5). Reprinted in U.S. Congress, Senate, 1975, pp. 177-236.

IR&D funding of development of the commercial JT9D engine by Pratt & Whitney in the late 1960s and early 1970s demonstrates the difficulty of assessing the allowability of IR&D costs. It raises the question of allowing the government access to commercial records to determine if prior contracts required later R&D proposed as IR&D, and whether distinctions can be drawn, for these purposes, among work "sponsored by" a commercial contract, work "required in fulfillment of" such a contract, and work that merely enables a company to fulfill such a contract.

In 1966, Boeing placed orders with Pratt & Whitney for engines with certain specifications for the 747. In 1967, Pratt & Whitney proposed the development of an engine of the same specifications as IR&D to be charged against DOD contracts during 1968; the costs were allowed. In fulfillment of the contract with Boeing, the JT9D engine was delivered in April 1971, and newer models continued to be developed. DOD continued to pay IR&D costs for these same developments.

The Air Force representative in negotiations with Pratt & Whitney questioned whether these costs were allowable as IR&D in 1971. In response to this and similar questions, the Armed Services Procurement Regulations (ASPR) were reworded so that IR&D reimbursal would exclude not only work "sponsored by" contracts but also work "required in fulfillment of" contracts, effective January 1972.

The General Accounting Office requested information from Pratt & Whitney concerning the Boeing contracts, to determine if such costs should have been allowed as IR&D. Access to Pratt & Whitney commercial records was denied. GAO then requested that the Secretary of Defense determine whether the IR&D costs of developing the JT9D engine should have been disallowed as IR&D, and whether

price adjustments should be made to reimburse DOD for IR&D costs from 1968 to 1973.

Under GAO's interpretation, the research leading to the development of the JT9D was required to fulfill contracts with Boeing. Pratt & Whitney maintained that the entire research and development effort was allowable as IR&D, since commercial contracts did not specifically require the development of that engine. Pratt & Whitney bore the full risk of failure.

The Navy's interpretation differed from those of both GAO and Pratt & Whitney. In the Navy's opinion, the 1972 change in wording of ASPR Sec. XV was crucial, in that JT9D R&D was not "sponsored by" Boeing, but was "required in fulfillment of" a contract with Boeing. Prior to 1972, therefore, development of this engine was allowable IR&D. Further, the Navy stated the government could not attempt to recover costs during 1972 since the Navy's acceptance of the costs had "estopped" the government from pressing a claim. 1973 costs were not allowable as IR&D.

GAO and the Navy arrived at different calculations of DOD IR&D reimbursements that should be applied to JT9D development. GAO considered the costs of JT9D development as a fraction of Pratt & Whitney's total IR&D expenditures and applied that fraction to DOD IR&D payments over the same period. According to this calculation, DOD had paid \$76.1 million for JT9D engine development. The Navy allowed all IR&D costs above the negotiated ceiling to be considered JT9D development costs. Applying this smaller fraction to DOD IR&D payments, the Navy calculated that DOD had paid \$48.9 million for development of the JT9D engine.

GAO recommended in September 1975, that the Secretary of Defense determine whether costs paid to Pratt & Whitney as IR&D between 1968 and 1973 should have been disallowed and, accordingly, to adjust prices to reimburse DOD. GAO also recommended that advance agreements with DOD should include access to commercial records when allowable IR&D costs are clearly in question, and that DOD should monitor the development of products which clearly have potential commercial application when allowed as IR&D costs.

. 1974c. Partial Report--In-Depth Investigation into Independent Research and Development and Bid and Proposal Programs. August 16. B-164912. Washington, D.C.

. 1975. Contractor's Independent Research and Development Program--Issues and Alternatives. Report to the Subcommittees on Research and Development, Senate Committee on Armed Services, and Priorities and Economy in Government, Joint Economic Committee. June 5. Washington, D.C.: U.S. Government Printing Office (PSAD-75-82). Reprinted in U.S. Congress, Senate, 1975, pp. 12-119.

This report was the result of a study made at the request of Sen. Thomas J. McIntyre and Sen. William Proxmire, chairmen of the subcommittees to which the report is addressed. It recommends the following:

[I]f financial support for IR&D is to be continued, the Congress [should] clarify the policy for such support by establishing guidelines which set forth:

- The purposes for which the Government supports IR&D costs.
- The appropriate amount of this financial support.
- The degree of control to be exercised by the Government over contractors' supported programs.

It further commends to the Congress' attention the policies proposed in dissenting position 1 of the Commission on Government Procurement's treatment of the IR&D/B&P issue. (See Commission on Government Procurement, 1972.) That position favored uniform government-wide treatment of IR&D expenses, the retention of DOD negotiation procedures, and agency relevancy requirements; it recommended also that the government obtain sufficient access to contractors' commercial records to determine when necessary whether costs are allowable. (See Comptroller General, 1974b.) In addition, dissenting position 1 recommended that the government include in advance agreements provisions granting the government royalty-free licenses and data rights, "based on a scale of the agencies' cost participation."

The report suggests:

If the Congress proceeds as above, the federal agencies should consider:

- Having contractors continue to propose annual programs to the Government so that technical data would be added to Government data banks.
- Making technical reviews less structured and not as administratively burdensome, and encouraging intensive reviews and exchange of views between Government and contractor personnel on defined areas of common concern.

. 1977a. Need to Prevent Department of Defense from Paying Some Costs for Aircraft Engines that Contractors Should Pay. Report to the Congress. February 28. Washington, D.C.: U.S. Government Printing Office (PSAD-77-57).

In this report the Comptroller General makes two recommendations and comments on a third made by DOD. GAO recommends that the definition of IR&D be narrowed to exclude costs undertaken to correct operational problems of inservice products, termed "product support." Secondly, GAO recommends that the government should be given access to contractors' records to determine whether doubtful IR&D costs are allowable. Legislative action should be taken if necessary to provide such access. GAO comments further that DOD has offered an alternative recommendation, that access to commercial records may not be necessary if a specific set of questions were completed and certified to by contractors, indicating that proposed IR&D costs are allowable. GAO recommends that this "questionnaire test project" be monitored by the Secretary of Defense to verify that sufficient data are provided by the questionnaire.

The basis for recommending narrowing the definition of IR&D was a series of problems with IR&D reimbursements to Pratt & Whitney and General Electric. GAO points out that Boeing, McDonnell Douglas, the Navy, and the Air Force agree that product support is not allowable IR&D. Boeing and McDonnell Douglas do not charge such costs to IR&D, but GE and Pratt & Whitney do.

Pratt & Whitney has charged product support costs, as well as costs of designing display tables for commercial engines and product evaluation for alternate vendor selection, to IR&D, although Pratt & Whitney states that it agrees with the GAO definition of IR&D. GE maintains that the GAO is incorrect in its definition, that all costs not specified in contracts are allowable, and, furthermore, that purchase orders do not constitute contracts.

Both GE and Pratt & Whitney have used IR&D funding to correct in-service aircraft engine problems and have maintained when questioned that IR&D funds were used to correct similar problems in newer engines, and these measures were then found to apply to the engines in service, too. Replacement parts and labor were provided without charge to customers. According to GAO, this arrangement suggested an implied or stated warranty, and the government should not pay these repair costs.

The problem of access to commercial records to verify IR&D costs was exacerbated by GE's and Pratt & Whitney's denials of access to records that had been used in negotiating IR&D ceilings or had been distributed to customers. GE denied access to engine warranties; Pratt & Whitney denied access to "histories of engine problems and corrective actions taken," sometimes after as much as ten weeks delay. GAO recommended that defense contractors be required to maintain sufficient records to verify allowability of IR&D costs, and that such records be made available when legitimate questions arise. In response to DOD's suggestion that a questionnaire be used to receive assurances of allowability from contractors, instead of requiring

access to commercial records, GAO recommended that the Secretary of Defense monitor the development of this questionnaire.

DOD agreed (on August 13, 1976) that the definition of IR&D should be clarified to exclude product support required by contract.

Following the GAO recommendation of February 1977 that the Armed Services Procurement Regulations be revised to narrow the definition of IR&D, GAO received a letter (November 1977) from the Undersecretary of Defense for Research and Engineering, stating that the definition would not be altered as it was already sufficiently specific. According to GAO, three reports urging clarification of the definition of IR&D had already been issued (Comptroller General, 1974b, 1975, 1977a), and no further effort would be made by them.

In response to the recommendation that access to commercial records be allowed in cases of questionable IR&D costs, the Undersecretary responded (May 1977) that contractors are required to certify that no proposed IR&D costs are explicitly or implicitly required by contract. In the opinion of the Undersecretary, it is therefore unnecessary to develop the questionnaire or pursue the question of access to contractors' records.

GAO responded (Comptroller General, 1977b) that this arrangement was not sufficient to verify that proposed IR&D costs are allowable as government expenditures. No further correspondence was received.

. 1977b. Letter to the Secretary of Defense (n.d.; received August 25).

Council on Economic Priorities. 1976. "Contingency Costs." CEP News-letter. August 30.

Dean, B. V. and Joel D. Goldhar, eds. 1980. Research and Innovation Management. Vol. 15, Studies in the Management Sciences. Amsterdam, New York, and Oxford: North-Holland Publishing Co.

Defense Contract Audit Agency. 1980. "Summary of Independent Research and Bid and Proposal Costs Incurred by Major Defense Contractors in the years 1978 and 1979." March.

Defense Science Board. 1975. "Report of IR&D Task Force." March.

DGS Associates, Inc. 1976. "A Postulated IR&D/B&P Policy Revision." Washington, D.C.: DGS Associates, Inc. October 15.

This report discusses in a good deal of detail the current system for funding IR&D and B&P, and analyzes an NSF-postulated change in policy, intended to work with the provisions of OMB Executive

Circular A-109 (see Office of Federal Procurement, 1980) to encourage more work on the early and more speculative stages of R&D and at the same time enhance competition in the later stages. The revised program (apparently assumed to be used government-wide) would divide what is now known as IR&D into two separate elements: independent research (IR), roughly equivalent to NSF's "applied research" and prior stages, and independent development (ID). Bid-and-proposal costs would cease to be allowable as a separate category of indirect expense, and would be largely absorbed by ID allowances. The report says (pp. 40-41):

IR allocations would support:

- the gaining and communication of non-applied knowledge and
- the creation and communication of ideas and design concepts.

ID allocations would support:

- current product improvement technical and communication activities to prepare information suitable for engineering contract change proposals (ECP's).

IR funding would be subject to a rather broad relevancy test; an agency would reimburse IR expenses if the project proved potentially useful to it or any other federal agency's mission. IR projects could lead to competitive design contracts leading to preliminary design. Reimbursement of ID expenses would be restricted to improvements in products already being procured under contract; furthermore, work leading to concepts beyond the preliminary design phase would not be allowable as indirect expenses, but could be funded under contract.

The authors of the report, using an assumed distribution of federal R&D activity among the various stages of research and development, concluded that:

Overall,...contractors would maintain their current level of indirect technical and proposed activity, but their contracted R&D activity would increase by about 15 percent.

They state further that the revised policy, in concert with OMB Executive Circular A-109, would reduce the cost of entry into the federal contract market and thus "open up the seller's marketplace to smaller firms now excluded..." They say it would also provide broader technical alternatives, reduce the roles of federal labs in work beyond the conceptual design stage, and "improve federal expen-

diture accountability and yet retain technological freedom in choosing conceptual solutions to national needs."

The report includes (pp. 61-64) a list of research issues and a 41-page annotated bibliography.

Executive Office of the President, Office of Management and Budget.
1976. OMB Considerations of an IR&D Policy. September 30.

Gamota, George. 1980a. "RDT&E & IR&D: DOD Corporate Perspective."
Paper presented to Third Annual Conference on R&D, October.

This paper emphasizes the importance of research and development in improving products and services and enhancing competition. DOD funds 44 percent of government-supported R&D, amounting to 10 percent of the DOD budget. Their breakdown of research areas includes engineering development (36 percent), exploratory development (13 percent), advanced development (19 percent), operational systems development (19 percent), management and support (11 percent), and basic research (4 percent). Defense Secretary Brown has sought to increase basic research funding by DOD.

Soviet R&D programs are much more extensive than US programs, but they lack IR&D, which has contributed greatly to US military technology. IR&D programs achieve for DOD: greater access to competent contractors who are aware of DOD needs, increased technological options, reduced risks in contract funding, improved backgrounds for negotiating contracts that require shorter times for completion, and more efficient spending of tax dollars. Thus IR&D spending, which averages only 2-8 percent of contract value, is an "ingenious device" and a bargain. Bid and proposal costs enable preliminary study of design and modeling and building prototypes, and result in more efficient spending on later contracts.

The Technical Evaluation Group of DOD, which Dr. Gamota heads, is made up of three departmental IR&D managers. It establishes procedures for evaluating company IR&D programs, reviews such programs, and maintains the DOD IR&D data bank.

Every major DOD program has benefited by developments in IR&D programs, e.g., the Airborne Warning and Control system, transonic fighter, cruise missile, laser-guided missiles, and guidance electronics. But, while IR&D in the area of development engineering has increased, especially in aerospace and electronics, IR&D in basic research has declined. Gamota recommends programs that promote cooperation among industry, government labs, and academic institutions, such as the NAS meetings at which DOD needs in specific academic disciplines are discussed.

. 1980b. "The Department of Defense Statement on Independent Research and Development." Paper presented to Committee on IR&D Issues, National Academy of Sciences, Washington, D.C., December 8.

Herr, Karl G. n.d. "The What's and Why's of Independent Research and Development." Defense Management Journal.

IEEE Spectrum. 1976. "Independent R&D: Three Viewpoints." November, pp. 50-53.

Brief statements by Sen. William Proxmire, Max Heller (Director of Research, Martin Marietta Aerospace), and Malcolm Currie (Director, Defense Research and Engineering, DOD). Proxmire criticizes the IR&D program for its lack of accountability to Congress: "Public spending without public accountability is as wrong as taxation without representation." Heller stresses efficacy of market decisions in controlling IR&D expenditures, and the importance of maintaining strong defense research establishments in private industry. Currie outlines the traditional DOD position: the program fosters independence and freedom to innovate without direction from the government, competitive approaches to problems, and maintenance of strong and stable research establishments in industry.

Machinery & Allied Products Institute Memorandum. 1980. "Research and Development Spending in the Capital Goods Industries--A Status Report." September 24. Washington, D.C. (G124).

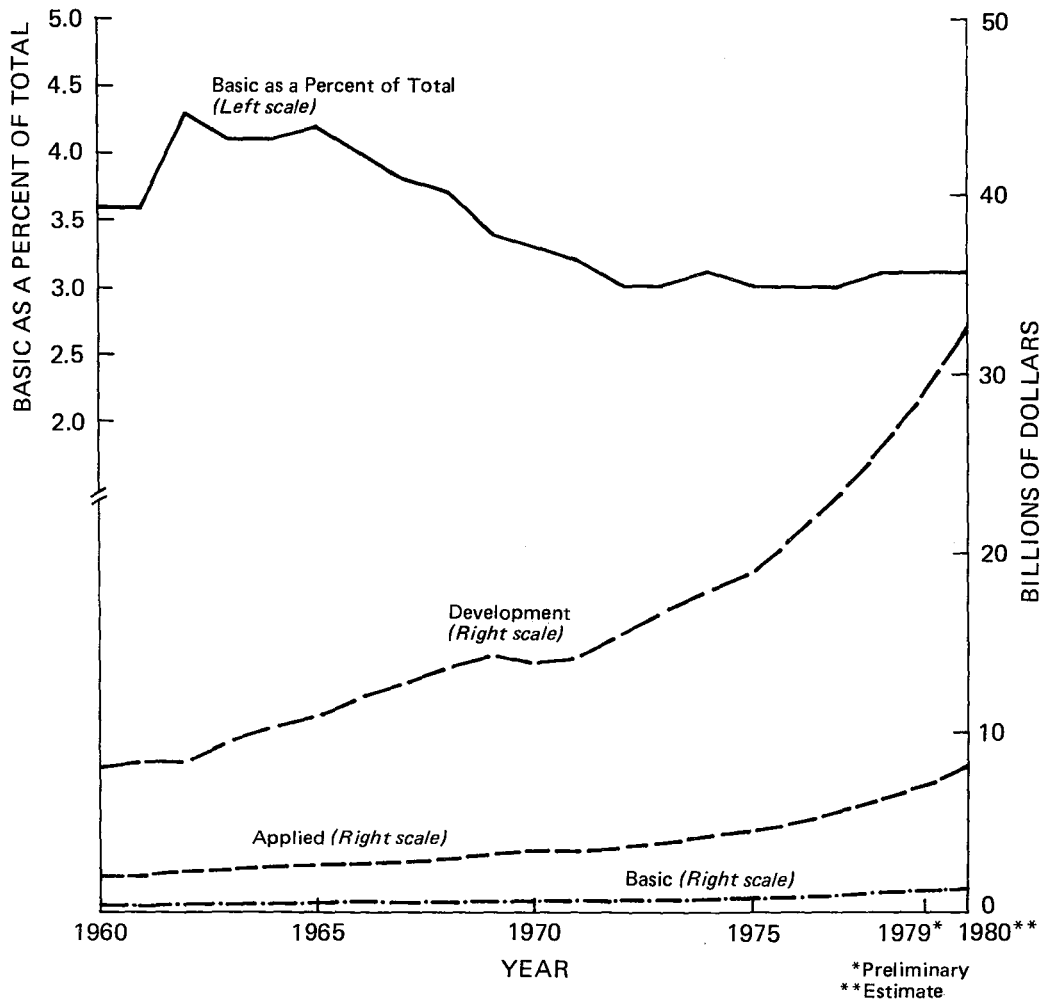
Research and development expenditures, in total and as a percentage of sales, have leveled off (in constant dollars), but in capital goods rates of R&D expenditures are twice that of manufacturing as a whole. Since 1975, industry funding of R&D has increased greatly in comparison with government and university support. The industry bias toward applied research and development ("bringing a specific product onstream") has immediate economic rewards but does not encourage innovation over the long term.

- Two graphs: 1960-1980 spending on basic and applied research and development (Exhibit B); 1960-1980 R&D spending by source of funds (Exhibit C).

Murrin, T. J. 1980. "Business Meets Problems." Government Executive June.

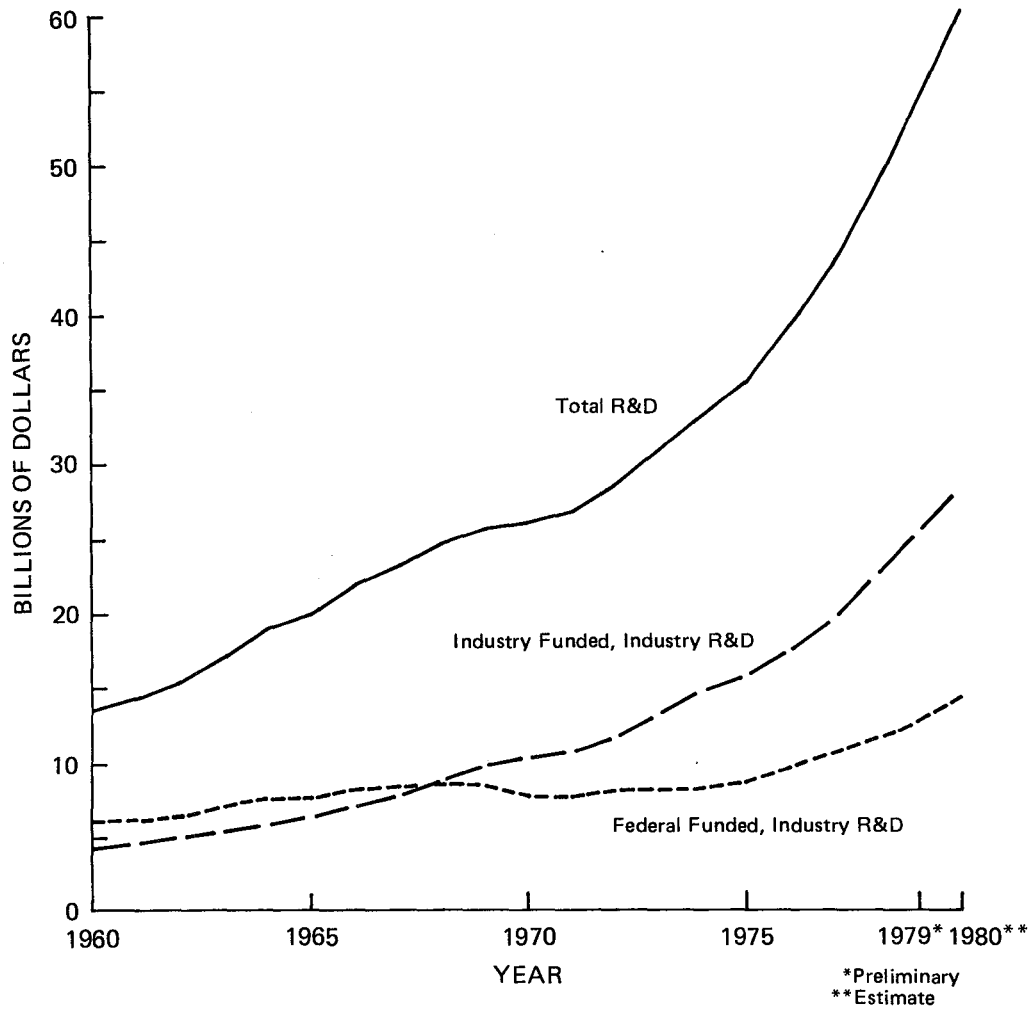
The government is a difficult customer, demanding audit rights, attempting to control suppliers' profits, demanding documentation, claiming termination-for-convenience rights, and imposing regulations that increase costs to industry. Murrin suggests policies for government contracts that recognize the long-term needs of industry and the importance of innovation to increased productivity. Specific recommendations include lifting IR&D ceilings, adopting full reimbursement

EXHIBIT B



1960-1980 spending on basic and applied research and development
(Machinery and Allied Products Memorandum, 1980)

EXHIBIT C



1960-1980 R&D spending by source of funds (Machinery and Allied Products Memorandum, 1980)

of allocable IR&D expenses, and adopting national programs for technology improvement, such as the ICAM program. Quality assurance programs should emphasize QA during product design, development and testing, rather than checking final products, and fewer tests should be required of companies with good records.

Less frequent, longer term documentation would reduce paperwork, which often amounts to 20-40 percent of R&D costs. Appropriate inflation indices should be developed. Investment deterrents should be removed by implementing replacement cost depreciation, multi-year procurements, advance payment policies, and trigger-price mechanisms.

Office of Federal Procurement Policy, Office of Management and Budget.
1980. "Proposal for a Uniform Procurement System" (Draft). September 12.

Olstad, Walter B. 1980. "NASA Views on IR&D." Paper presented to the Committee on IR&D Issues, National Academy of Sciences, Washington, D.C., December 8.

Orkand Corporation. 1973. Monopsony: A Fundamental Problem in Government Procurement. Washington, D.C.: Aerospace Industries Association of America, Inc., Aerospace Research Center.

The defense procurement market is largely a monopsony; the government is for many contractors the dominant or only customer. This deviation from free market conditions is a significant factor in the American economy. During the 1960s over 80 percent of sales of the aerospace industry, for example, were made to the government. Overall, government purchases equal 10 percent of GNP, and three-fourths of these are for defense.

In a monopsony, the purchaser wields far more power than it otherwise would, and its interests are protected, sometimes to the point that the seller is forced out of the market. Government selection of contractors is expensive, involving lengthy and technical RFPs and proposals. Legitimate costs of doing business (advertising, interest, charitable contributions) are not recoverable; others, such as IR&D, are subject to ceilings. Contracts are renegotiated if profits are seen as excessive, while major losses are not compensated.

Reporting requirements are burdensome and raise overall costs, which may not be recovered. Government monitoring sometimes requires changes in management decisions, such as the selection of subcontractors and wage policies. Profit margins are lower than on commercial contracts, as percentages of sales, total capital invested, or equity capital invested.

Unexpected changes in government procurement policies, budget cuts, and retroactive regulations can impose severe hardships. When complex, state-of-the-art systems are demanded, the specialization

involved in developing the necessary technical and production skills and management and marketing techniques limits the ability to transfer resources to new product lines. In the long run, government programs are compromised by weakening defense industries.

This report suggests that Congress should establish a Government Procurement Practices Board to promote free market principles in negotiating government contracts. Congress should continually review policies and regulations, and a uniform set of procurement principles should be enacted into law. Proposed principles include increased profit margins in defense contracts, government reimbursement for advertising and other legitimate business expenses, reduced regulations, and the right to review of procedures when requested by industry.

Paine, Christopher, and Jordan Adams. 1980. "The R&D Slush Fund." The Nation. January 26, pp. 72-75.

This article criticizes the IR&D program for having no effective congressional oversight. The program supports as much as 72 percent of the total research effort in some companies (see table); international arms-control agreements are undercut by continuing systems developments ("technology creep"--e.g., cruise missile, F-16, F-5). IR&D funding actually supports developments for purely commercial gain. Government advocates of present IR&D reimbursement policies have received top jobs in companies participating in the program. The program does not stimulate competition; rather, it reinforces the market position of established defense contractors and pressures others to conduct military research. Sixty-five percent of IR&D funding has resulted in immediate DOD contracts or incremental improvements in existing systems. Contractors exert too much influence on DOD policy decisions, and some have threatened to stop work for the government if IR&D funding is cut.

- Table shows estimated proportion of R&D costs reimbursed by DOD to several major contractors (Exhibit D).

Pelz, Donald, and Frank Andrews. 1976. Scientists in Organizations (rev. ed.). Ann Arbor, Mich.: Institute of Social Research, University of Michigan.

Reppy, Judith. 1976. "The IR&D Program of the Department of Defense." Occasional Paper No. 6. The Peace Studies Program. Ithaca, N.Y.: Cornell University.

IR&D is paid for out of the defense procurement budget as overhead or administrative costs, not out of the defense research budget. Complaints about the lack of public accountability of this billion-dollar-per-year program led to Senate hearings in 1975, where defense contractors testified to the incentives for innovation, creativity,

EXHIBIT D

Company	Company R&D Investment (noncontract) (1973-1978)*	(IR&D Reimbursed by Dept. of Defense (1973-1978)	Percentage Reimbursed
Boeing	1110.6	206.6	18.6
E-Systems	53.4	14.9	27.9
General Dynamics	159.8	70.0	43.8
Grumman	255.6	67.1	26.3
Hughes	N.A.	155.0	N.A.
LTV	145	75.0	51.7
Litton	340.6	32.2	9.5
Lockheed	307.7	151.7	49.3
Martin Marietta	107.4	77.5	72.2
McDonnell Douglas	812.8	123.2	15.2
Northrop	173.1	112.5	65
Raytheon	290.4	154.2	53
Rockwell	527.1	154.3	29.3
TRW	228	55.5	24.4
United Technologies	2030.6	294.9	14.5

*Disclosure of company research and development investments is extremely uneven. As far as possible, C.E.P. has excluded cash-flow to contracts for research and development under direct Department of Defense contracting, in order to isolate company-sponsored research and development work.

Reprinted from Paine and Adams (1980), p. 73.

strengthening of the technology base, and increased competition that result from IR&D payments.

Critics described the lack of accountability for the large expenditures involved, the stifling of competition through contract supplements to the largest contractors, and abuses of IR&D funding. Defense Department management of IR&D was criticized in that technical evaluations have little effect on negotiated ceilings; on-site reviews are superficial and take place only every three years. Broader opposition to the program stems from the view that military decisions depend in part on the available technology, and to this extent, IR&D investments constitute pressure for military development in the same direction as IR&D.

Reviewing a company's IR&D plan and negotiating its costs continue while IR&D proceeds, but neither changes in the plan nor completed projects are reviewed. A difficulty arises for DOD in ensuring that the negotiator has the expertise to evaluate new research.

Defense procurement is an unusual market situation, in that the product is sold to one customer and is rapidly obsolete. Through the IR&D program some of the financial risk is shared by the government. Relatively low rates of profit in defense purchases are offset by the IR&D supplement. Patent rights are retained by the company. The industry's chance of future contracts is enhanced through careful selection of IR&D, but at the same time, this detracts from the creativity and flexibility for which the program strives.

Recommendations are that Congress should state the objectives of the IR&D program; alternative means for achieving these goals could then be reviewed. Congress should not absolve itself of the responsibility for oversight: names of companies receiving IR&D funding, the general nature of their work, and the amount of money received should be known. DOD should at some point review completed projects and adopt the Air Force procedure for linking ceilings to technical evaluations. The possibility of shifting advanced IR&D to contract status should be considered. IR&D should emphasize basic and applied research and exploratory development. DOD should consider the possibility of negotiating a higher rate of profit, which could then support independent research without advance agreements or further negotiation.

. 1977. "Defense Department Payments for 'Company-Financed' R&D." Research Policy 6:396-410.

IR&D reimbursements are reported to the National Science Foundation as company rather than government expenses.

Some IR&D projects are derived directly from contract work, as when an alternative means to a contract goal is the subject of testing. On-site visits by DOD officials during contracts are

occasions for guidance on future IR&D. In general, one-half of IR&D projects result in DOD contracts, thus reducing the risk to contractors of doing defense-related research. Patent rights are vested entirely in the company, whereas under contract R&D the government retains the right to royalty-free use.

Although it is estimated that the ten largest defense contractors receive 45 percent of IR&D funds from DOD, it is difficult to determine this more precisely because amounts paid to companies or divisions are treated as proprietary information. These payments amounted to about 20 percent of company-financed R&D in the aerospace industry in 1973.

Because of the close links between IR&D funding and DOD contracts--the same companies, the same scientists, and often the same projects, first through IR&D and then contract funding--it would be more appropriate to treat and report IR&D as federally-financed R&D rather than as company-financed R&D, as it is now.

- Table of costs incurred, accepted, and paid by DOD and NASA (Exhibit E).

Reppy, Judith, and F. A. Long. 1976. "The Pentagon Program of IR&D: The Need for Reform." Bulletin of the Atomic Scientists 32 (Jan.):30.

Salata, Michael F. 1976. "Independent Research and Development--Issues and Alternatives." Defense Systems Management School, Study Project Rep. 76-1. May 16. Fort Belvoir, Va.

Soergel, D.G. 1975. "Statement Before the Subcommittee on Research and Development and the Subcommittee on Priorities and Economy in Government," Joint Economic Committee Hearings on Contractors' Independent Research and Development, September 29, 1975. In U.S. Congress, Senate, 1975.

Present DOD contract procedures allow relatively late entry into the acquisition process, at late stages of development and production, making costs of preparing requests for proposals (RFP's) and proposals higher due to the need to consider technological constraints. IR&D/B&P expenditures are lower and opportunities for innovation in conceptual design are greater when RFP's include only broad statements of goals and operating constraints. Smaller firms with innovative ideas can then compete more effectively.

Research, in IR&D, is more truly independent than is development, while perhaps 90 percent of IR&D reimbursements are for development. During the 1960's this allowed government negotiators to select and verify specifications without R&D contracts. Once a particular design was selected, several contractors could compete, but these

EXHIBIT E

Size of IR&D/B&P Program, Major Contractors (millions of dollars)

Year	Costs incurred		Costs accepted		DOD payments		NASA payments		Total government payments IR&D/B&P
	IR&D	B&P	IR&D	B&P	IR&D	B&P	IR&D	B&P	
1963	389	236	255	230	197	178	24	23	422
1964	419	252	272	245	199	182	50	43	472
1965	439	277	300	271	198	186	60	55	499
1966	502	315	357	302	224	202	69	68	563
1967	591	338	439	325	277	230	58	50	615
1968	776	381	579	367	338	271	61	46	716
1969	808	426	653	409	410	289	43	49	791
1970	753	413	597	398	376	278	44	48	746
1971	703	427	567	390	354	265	41	51	711
1972	936	469	725	432	392	306	40	50	788
1973	1164	553	876	515	441	360	40	49	890
1974	1175	551	921	506	467	356	39	39	901
1975	1224	595	1010	543	493	384	40	38	955

SOURCE: 1964-67: U.S. Congress, Senate, Committee on Armed Services, Ad Hoc Research and Development Subcommittee, *Appendix to the Hearings, Department of Defense Funding of Contractors' Independent Technical Efforts*, 91st Congress, 2nd Session, pp. 2576-77.

1968-72: General Accounting Office, *Partial Report—In-depth Investigation into IR&D and B&P Programs*, B-164912 (Aug. 16, 1974) p. 6.

1973-75: Annual Report on IR&D/B&P, 1974 and 1975, *Congressional Record* (Apr. 9, 1975) S-5563 and (April 6, 1976) S-5026.

NASA, 1963-75: Supplied by NASA.

Reprinted from Reppy (1977), p. 403.

were almost always the larger firms whose earlier IR&D programs had been well funded.

Soergel suggests that accepting competitive bids earlier in the process would reduce IR&D expenditures, encourage real competition, and give greater accountability to the IR&D program. (See DGS Associates, 1976.)

Steiner, Gary A. 1965. The Creative Organization. Chicago: University of Chicago Press.

Talley, Earl H., and John T. Viola, 1977. "Independent Research and Development: The Technical Evaluation Process." Defense Systems Management School, Study Project Report 77-2. Fort Belvoir, Va.

Tri-Association Ad Hoc Committee on IR&D and B&P. 1974a. "A Position Paper on Independent Research and Development and Bid and Proposal Efforts." March 22. Washington, D.C.

_____. 1974b. "Executive Summary of a Position Paper on Independent Research and Bid and Proposal Efforts." March 22. Washington, D.C.

_____. 1974c. Technical Papers on Independent Research and Development and Bid and Proposal Efforts. March. Washington, D.C.

Six papers marshal the economic, technical and political evidence in support of broadened IR&D and B&P funding:

1. Economic Considerations Regarding IR&D and B&P Expense (Selected headings: "Why each company is the best judge of what it should be developing today," "Inconsistent thinking concerning IR&D and B&P expense," "Use of IR&D as an all-embracing term including B&P effort is misleading and confusing," "Industry should retain all patent and license rights on IR&D inventions").
2. Alternative Methods of IR&D and B&P Cost Reimbursement (Selected headings: "Criteria for evaluation of alternative methods of IR&D and B&P cost recovery," "Alternative methods for government reimbursement of IR&D and B&P costs"). [See following entry for details.]
3. Benefits Derived from IR&D Effort (Selected headings: "Overall benefits of IR&D," "How IR&D addresses DOD needs," "Examples of IR&D benefits").
4. Benefits Derived from B&P Effort (Selected headings: "Competitive environment," "Diversification").

5. U.S. and Foreign Nation Support of Industrial Technical Effort (Selected headings: "Comparing U.S. with foreign R&D activities," "Appendix A: Foreign R&D incentives," "Appendix B: Selected federal government financial assistance programs of direct and indirect benefit to industry").
6. Industry Response to 22 Proxmire-McIntyre Questions (Answers to questions asked by the two senators in requesting that the General Accounting Office undertake a comprehensive review of IR&D and B&P expenditures. The letter requesting the study, dated Oct. 8, 1973, was signed by McIntyre as Chairman of the Research and Development Subcommittee of the Armed Services Committee and by Proxmire as Chairman of the Senate Subcommittee on Priorities and Economy in Government).

_____. 1974d. "Alternative Methods of IR&D and B&P Cost Reimbursement." In Tri-Association Ad Hoc Committee, 1974c, pp. 16-25.

The objectives of government reimbursement of IR&D costs are to enhance the security of the U.S. through the maintenance of a strong defense industry, advance the technology base, foster competition, and ensure the economic survival of the defense industry. Several alternatives to the present method of reimbursement have been suggested. Criteria for judging these alternatives are (1) the effort required for financial accountability, (2) the effort required for technical accountability, (3) reimbursement of sufficient costs to encourage contractors to do business with the government, (4) the amount of extra administrative work necessary to manage and report IR&D, (5) the extent to which cost allocations are applied equitably to all customers, (6) contractor flexibility with respect to resource utilization, (7) accommodation to changes in contractor sales levels, (8) accommodation for unavoidable cost changes, (9) consistent government funding from year to year, (10) enhancement of the competitive strength of the contractor, (11) promotion of the survival of the "fittest" contractors, avoiding subsidies of weaker companies, and (12) safeguards against excess charges on government contracts, which might make advance agreements appropriate when a contractor operates entirely on sole-source federal contracts.

Alternative methods of IR&D reimbursement include: (1) reliance on the inherent constraints in a competitive market, by removal of all government controls except reasonableness and allocability; (2) rating contractors according to the percentage of commercial and fixed-price contracts, and allowing contractors with high ratings to demonstrate only reasonableness and allocability; others would negotiate ceilings and advance agreements; (3) using present methods

of reimbursement without the requirement of potential military relevance (PMR); (4) applying the formula presently applied to small contractors to all contractors; (5) using the present methods of reimbursement, including the PMR requirement; (6) identifying funds available for IR&D as a line item in the agency budget, and allocating that amount to contractors either according to costs incurred or under a level-of-effort contract for R&D; (7) allowing cost recovery through negotiation of increased profit margins on DOD contracts; (8) deferred cost recovery through directly-related sales; (9) the method used by the Atomic Energy Commission, whereby cost recovery was limited to allocable IR&D projects directly related to a particular contract, with limits on B&P cost reimbursements.

Applying the above criteria to these nine alternative methods, alternatives 1 and 2 are seen as preferred methods for government reimbursement of IR&D and B&P costs (see matrix attached).

- Matrix compares alternative funding methods (Exhibit F).

Trueger, Paul M. n.d. Accounting Guide for Defense Contracts. Chicago: Commerce Clearing House.

Twiss, Brian. 1974. Managing Technological Innovation. London and New York: Longmans Group Ltd.

U. S. Arms Control and Disarmament Agency. 1980. World Military Expenditures and Arms Transfers 1969-1978. Publication 108. Washington, D. C.: United States Arms Control and Disarmament Agency.

U.S. Congress, Senate. 1970. "Department of Defense Funding of Contractors' Independent Technical Efforts." Ad Hoc Research and Development Subcommittee of the Committee on Armed Services. March 2. Washington, D.C.: U.S. Government Printing Office.

_____. 1975. Independent Research and Development. Hearings before the Subcommittee on Research and Development of the Committee on Armed Services, and Subcommittee on Priorities and Economy in Government of the Joint Economic Committee. 94th Cong., 1st sess. Washington, D.C.: U.S. Government Printing Office.

U.S. Congress, Office of Technology Assessment. 1978. Government Involvement in the Innovation Process. A Contractor's Report to the Office of Technology Assessment. Washington, D.C.

U.S. Department of Defense. 1975. Department of Defense Instruction: Establishment of Policy for, and Administration of, Independent Research and Development Programs (IR&D)." January 7. DODI 5100.66. Washington, D.C.

EVALUATION OF ALTERNATIVE METHODS FOR GOVERNMENT RECOGNITION OF IR&D AND B&P COSTS

Criteria \ Method	A	B		C	D	E	F		G	H	I
	Inherent Economic Constraints In Competition	CWAS Plus Present Method w/o PMR (1)		Present Method w/o PMR (3)	Present Formula Universally Applied	Present Method	Budget Line Item (2)		Recovery Through Profit Negotiation	Recovery of Development Costs Deferred to Related Sales	AEC Method
		CWAS	Non-CWAS				1. Direct * Contract	2. Level of * Effort Contract			
1. Effort Required for Financial Accountability	Accountability Normal and Cost Effective	←	→	Accountability Normal; Effort Reasonable	Normal Account-ability; Effort Acceptable	Accountability Normal; Effort Acceptable	Accountability Normal; Effort Prohibitive	Accountability Normal; Effort Reasonable	Govt. Account-ability not Required	Accountability Impossible; Effort Prohib-itive	Accountability Normal; Effort Reasonable
2. Effort Required for Technical Accountability	Accountability Normal and Cost Effective	←	→	Accountability Normal; Cost Effective	Normal Account-ability; Effort Reasonable	Accountability Excessive; Effort not Cost Effective	Accountability Excessive; Effort Prohib-itive	Accountability Normal; Effort Reasonable	Govt. Account-ability not Required	Accountability Impossible; Effort Prohib-itive	Accountability Normal; Effort Reasonable
3. Reimbursement of IR&D Costs Sufficient to Motivate Continuance in Government Business	Excellent	←	→	Good	Excellent	Moderate	Poor	Poor	Very Uncertain	Very Poor	Very Poor
4. Administrative Economy and Practicality	Excellent	←	→	Good	Good	Moderate	Prohibitive	Poor	Excellent	Prohibitive	Good
5. Allocation Equitable to Total Business	Automatic	←	→	Automatic	Automatic	Automatic	Non-existent	Non-existent	Allocation Equitable; Recovery Very Uncertain	Non-existent	Non-existent
6. Contractor Flexibility with Respect to Resource Utilization	Excellent	←	→	Good	Good	Moderate	Non-existent	Depends on Latitude in Work Statement	Excellent	Good	Non-existent
7. Accommodation of Substantial Changes in Contractor Sales Levels	Excellent	←	→	Moderate	Moderate	Moderate	Unrelated	Good	Automatic	Good	Non-existent
8. Accommodation for Unavoidable Cost Changes, e.g., Inflation, etc.	Automatic	←	→	Moderate	Moderate	Moderate	Depends on Type of Contract	Good	Very Poor	Good	Non-existent
9. Consistent Govt. Funding to Permit Year-to-Year Program Continuity	Automatic	←	→	Good	Moderate	Good	No Assurance	No Assurance	Very Poor	Very Uncertain	Non-existent
10. Maintenance of Maximum Competitive Base in Govt. Procurement	Excellent	←	→	Good	Good	Moderate	Very Poor	Moderate	Very Uncertain	Poor	Very Poor
11. Promotion of the Survival of the Fittest Contractor	Excellent	←	→	Good	Good	Moderate	Very Poor	Poor	Excellent	Poor	Non-existent
12. Safeguards Against Excess Charges on Govt. Contracts	Controlled by Competition	←	→	Good	Good	Good	Excellent	Good	Avoids Issue	Very Poor	Excellent

(1) CWAS - The Contractor Weighted Average Share of Risk (CWAS) concept evaluates and assigns weighted ratings to sales commitments of contractors based upon competition prior to award and financial/technical risk in performance. Commercial and Government fixed price contracts receive a 100% rating and Government level-of-effort cost reimbursement type contracts, at the lower end receive a 0 rating. Each contractor is then given an annual average CWAS rating. The Armed Services Procurement Regulation (ASPR) specifies those costs to which the CWAS rating is applicable or inapplicable. Where CWAS applies and where a contractor has a sufficiently high CWAS rating (65%) his costs are subjected only to review for allocability.

(2) Inapplicable to B&P

(3) Potential Military Relationship

FIGURE 1

. 1977. "Point Paper on Independent Research and Development" (draft). August 11. Washington, D.C.

IR&D is contractor-initiated and conducted R&D not sponsored by contract or grant. It includes the full spectrum from basic research through development and system and concept formulation studies. In 1976 contractors incurred IR&D costs of \$1,323 million (in 258 DOD major contractor divisions); \$543 million was reimbursed by DOD. In addition, contractors incurred \$677 million in B&P expenses, of which DOD reimbursed \$415 million. IR&D averages about 8-10 percent of the major contractors' overhead costs. For major defense contractors, IR&D costs were about 2 percent of sales, and B&P costs 1.5 percent.

The DOD supervisory structure for IR&D /B&P consists of the DOD IR&D Policy Council (chaired by DDR&E), the Technical Evaluation Group, IR&D Policy Councils in each service, central negotiation offices in each service (for advance agreements), and \$3-4 million a year worth of annual technical evaluations and triennial onsite evaluations.

The history of IR&D management goes back to 1940 (Treasury Decision 5000, which provided cost principles for use in determining excess profits), and the 1942 War Department "Green Book," which "allowed research, experimental, and development costs devoted to future improvement and application of production." [The report describes important events in the history of IR&D reimbursal dating from these two documents, through the various ASPR revisions, GAO studies, congressional hearing, and so on, ending with the proposed Federal Acquisition Act of 1977.]

The lack of uniform treatment of IR&D and B&P by different agencies is a matter of concern, "but there is no immediate solution to the problem," which can be traced to non-DOD agencies' reluctance to "live with the relevance criterion" and to the DOD's allowance of B&P costs, which other agencies do not allow.

U.S. Department of Defense, Office of the Director of Defense Research and Engineering. 1967. Independent Research and Development: Report of the Defense Science Board Task Group. Washington, D.C.

U.S. War Department and Department of the Navy. 1942. Explanation of Principles for Determination of Costs Under Government Contracts. Washington, D.C.: U.S. Government Printing Office.

